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A Convenient Portable Photometer.

A VERY practical paper may be found in our columns this week treating the subject of a portable photometer. Not portable in the limited sense generally understood, but sufficiently compact and convenient to carry about for the purpose of testing street lights. Such an apparatus would often be extremely useful to central station companies in ascertaining the condition of their lights at various points. After a considerable amount of experimentation, Mr. Hering, to whom the problem was presented in a concrete form, hit upon a very neat modification of Bunsen's photometer, using as the standard of light a small electric lamp fed by a storage battery. No primary standard, such as a candle or a Methven screen, is sufficiently portable to answer the requirements, particularly as for the use intended the apparatus cannot conveniently be leveled. The incandescent lamp, however, just fills the bill; experience showed that when supplied with current by a small battery it was sufficiently uniform to give excellent results. The apparatus can be constructed of very small bulk, and comparatively little weight, so that it can readily be transported and used at any place where it becomes necessary. An extension of its employment is to the measurement of diffused light to determine the proper illumination of buildings, for example. Altogether it is a neat and ingenious little piece of apparatus that should prove sufficiently convenient to come into considerable use.

The Trolley Situation in Brooklyn.

THE startling and questionable action of Mayor Boody in Brooklyn in vetoing the trolley resolution has not as yet led to any very definite action on the part of either the railroad companies or the Board of Aldermen. It is claimed by the former that the resolution became a law through the failure of Mayor Chapin to act upon it within the ten days limit prescribed. In other words there is grave doubt whether the veto was not entirely unauthorized by law and too late to take effect. There is certainly a fighting chance for the railroad companies even if the Board of Aldermen fail to repass the resolution over the veto, and, even if this is not done, the State Railroad Commissioners may interfere. It does not seem at all likely that the street railways, after their long and persistent efforts to secure a change of motive power, are to be baffled by the action of a single prejudiced individual inspired by disgruntled property holders, even if uninfluenced by less worthy motives. Electric traction must come, and the sooner Brooklyn's obstreperous Mayor makes up his mind to submit to the inevitable the sooner will his constituents be gladdened by their first sight of genuine rapid transit. If analyzed, the real objections to the trolley system do not come from the rank and file of the people, who would be benefited by it, but from the machinations of those who are interested in other systems, or the blind and undemocratic prejudice of short sighted property holders.

Electric Arc Welding.

ONE of our English contemporaries has recently given a very complete account of the Bernardos arc welding process, as operated at the tube works of Lloyd & Lloyd in Birmingham, which we reproduce in our columns this week. Arc welding and the Thomson process seem to occupy quite distinct fields. The arc method has its peculiar usefulness in connection with large work in which the electric arc serves simply as a means of communicating very intense heat at the particular point necessary. As will be seen from the article in question it is applied with great effect to the manufacture of tubes, and gas, steam and water fittings generally. Until its introduction the makers were dependent on a powerful blowpipe for doing this rather delicate class of work, but the electric arc from its great power and convenience has proved to be immensely more effective than any form of blowpipe yet devised, in fact Lloyd & Lloyd report that the cost of the weld by this process is only one-fourth that which was usual when the blowpipe was employed. If will be noted that the Bernardos process is also widely different from the Coffin system of arc welding, which has already been used in this country. Of the two it must be confessed that Mr. Coffin's method is the more pleasing, since by the action of a magnet it converts a powerful arc into a blowpipe which can be handled so as to apply just the right amount of heat at just the point necessary. By the Bernardos process the arc is drawn between the metal itself and the carbon electrode. Inasmuch as the work forms the positive pole, the heat generated is very intense, but the process gives the impression of being less handy than the one just mentioned. It is certainly successful and enables a class of work to be very readily done which would be impossible by any other process. For example, fittings 12 inches in diameter can be made out of 5-16th inch metal cheaply and rapidly, a feat which would be exceedingly difficult if not impossible to perform by other means. Apparently, arc welding has come to stay, at least in its application to certain classes of work.

A Pacific Cable.

ONE of the interesting bits of work done by the United States government is the completion of soundings by the U. S. steamship Albatross for a submarine cable between some point on the American coast and Honolulu. The importance of this work can best be appreciated by imagining the conditions which exist on the ocean bottom, made up, as it is, of undulating plains and plateaus, deep valleys and high mountain ranges. Fancy the mechanical conditions, for example, which would exist were it attempted to lay a cable directly on the surface of the earth, following the backbone of the Rocky Mountains from the Mexican border to the 49th parallel. What material could endure the service with long lengths of cable stretched over valleys, bending over the edges of precipices, and lying, perhaps for miles, along ragged rocks. Plunge the whole several miles under the ocean, and you may have some appreciation of the conditions that render a survey absolutely necessary before any attempts are made to establish telegraphic communication. In laying the Atlantic cable the topography was most fortunate, for that ocean is, for the most part, rather shallow, and, as a matter of fact, the cable is laid on a comparatively smooth plateau stretching nearly from continent to continent. In the Pacific the conditions are vastly different, particularly in the western portion of the ocean, for in one of the surveys a deep valley east of Japan, was found stretching northward to the Arctic circle, and more than five miles in depth. Fortunately the conditions between the Sandwich Islands and the American coast are much better. The greatest depth encountered was less than four miles, and, for the most part, only two or three, with rather favorable gradations along the route. Eventually a Pacific cable is sure to be laid, and these elaborate soundings are the first important step. A few years will doubtless see the world literally belted by electric cables, so that if all communication between San Francisco and New York were cut off by tremendous storms, messages could conveniently go around the other way. And this is not a fancy picture, for something very like it actually occurred during the great blizzard of 1888, when messages were sent from Boston to New York via London.

Pictorial Telegraphy.

APROPOS of a recent suggestion about transmitting pictures by telegraph, we publish a very interesting communication by Mr. A. P. Trotter, of London, England, on experiments carried out with reference to the successful accomplishment of this task. The method he proposed was of a decidedly radical character, contemplating not the reproduction of a drawing, but the direct cutting of a block at a distant point, so as to produce a plate which could be immediately used for printing. The general plan was to join the well known system of Caselli with an engraving machine worked by an electromagnet, the design being drawn in non-conducting ink on a sheet of metal. The principal problem was to devise an electro-magnetic engraving machine of such a character that it could be worked at the high speed necessary for the purpose, and produce a block from which illustrations could be made at once. Mr. Trotter investigated two methods, one of them involving a drill process, the other an automatically moved graving tool. Experiments were carried out on this latter method with reference, not so much to the transmitting device, which would have to be virtually that of Caselli, as to the mechanical problem of producing a workable plate at the proper speed. The result was fairly satisfactory, and it proved to be possible to reproduce drawings, so far as the rapidity of the engraving was concerned, at the rate of about two square inches a minute. Actuating such an apparatus by means of any of the well known synchronizing devices it would be possible to reproduce in a newspaper office, for example, a sketch by an artist at a point many miles away. The result of Mr. Trotter's experiments, as shown in the fac-simile printed from the electrotype of the original block, was encouraging although not altogether successful. But it is possible that a result even better could be obtained by reproducing the drawing in cutting through a film upon a prepared plate which could afterward be rapidly etched by acid. The process used in Mr. Berliner's beautiful gramophone might, perhaps, be admirably adapted to such a purpose. The principal difficulty, however, with the pictorial telegraph probably is not electrical, for while success could doubtless be attained it is very questionable if the applications would be numerous enough to make it worth while to construct the apparatus. In other words the process is open to the grave objection of not filling any particularly long felt want.

Steam Turbine Tests.

OUR cable dispatch this week contains what to electrical engineers will appear a most remarkable and sensational experiment. It is the result of a careful test made by Prof. Ewing on a steam turbine and dynamo combination of 100-kilowatt capacity. The Parsons turbine has been known for some years, and has been given a considerable trial on a small scale. The excellence of the result of this last test, however, was hardly to be anticipated, even by the most visionary friends of the steam turbine. It was found that at full output an electrical horse-power hour could be obtained by the consumption of only 27.6 pounds of steam, while at half load but 29 pounds were required. If this result is confirmed, and there is reason to expect that it will be on account of the well known skill of the engineer who made the tests, its effects may prove to be very far-reaching. Nearly a year ago in discussing an American invention of a similar character—the Dow steam turbine*—we called attention to the wide field of usefulness that would be opened to such an apparatus if it should be found reasonably economical of steam. The present facts show not only reasonable but extraordinary economy, for 27.6 pounds of steam per horse-power is a figure that, it is safe to say, has never been reached by any simple high speed engine of the type of which there are thousands in use in electric light and power stations to-day, and is barely within reach even of compound engines when they are used non-condensing. And still more remarkable is the half-load efficiency. If either the Parsons turbine or its American compeer can give such results as this with the regularity that it is fair to anticipate in view of such favorable tests, the simple engine has found a competitor more formidable than even the most sanguine of engineers has felt justified in expecting. For not only is the steam turbine economical but it is cheap to build, occupies an exceedingly small amount of space, and is unusually free from mechanical complications. Furthermore, the high speed desirable in its use tends to the production of an extremely economical type of dynamo. High speed is the most efficient way of getting high voltages, so that the very conditions which have given such good results in the prime mover are most favorable to the dynamo itself. A 100-kilowatt steam dynamo of the type we are considering is a much smaller and cheaper machine than any similar combination which has as yet been devised, and quite capable of playing a most important part in central station equipment. The enormous output in proportion to the weight will render it desirable for marine use, while the immense economy of space gained at the same time will tell in its favor everywhere. It is hard now to estimate the importance which this new development in prime movers may assume. It certainly means active rebellion against small high speed engines, and may extend to open revolution against our present methods of central station practice.

* THE ELECTRICAL WORLD, Feb. 28, 1891.

Latest Foreign Electrical News.

(By Cable from Our Own Correspondent.)

London, Jan. 11, 1892.—The death of Sir George B. Airy, ex-Astronomer Royal of England, has just been announced. Sir George Biddle Airy was born in 1801, and while still a comparatively young man received the appointment of Astronomer Royal, and for many years, all through the last half century that has been so rich in theoretical investigations, held that responsible post. He is best known to electricians by his important work on terrestrial magnetism, a subject in which he was deeply interested. To him and to Sir Edward Sabine is due much of the knowledge on the subject that has been acquired during the last 50 years.

Death has also taken from us very recently Mr. Frederick Leyland, President of the National Telephone Company, widely known in electrical circles throughout the United Kingdom.

The tramways committee of the Glasgow municipality has, after long deliberations, lasting over the greater part of 1891, practically decided to try the accumulator on a large scale. It has been discussed from time to time at their various deliberations, but this last conclusion is very recent. A London firm has offered to run cars for fivepence (10 cents) per car mile.

Prof. J. A. Ewing has just concluded a test of a 100-kilowatt Parsons steam turbine and dynamo with results of a most remarkable character. His experiments show that at full output this combination machine gives an electrical horse-power hour on a consumption of 27.6 pounds of steam. At half load 29 pounds of steam sufficed for the same work. The speed was 4,800 revolutions per minute at a pressure of only 95 pounds per square inch, while the turbine was designed for 140 pounds pressure. These results are most extraordinary, and if confirmed by further experiments will prove revolutionary in their importance.

Electrical Goods Free of Duty.

The reciprocity agreement between the United States and San Salvador will go into effect on Feb. 1 next. Among the articles it is agreed to admit free are materials of all kinds for the construction and operation of telegraph and telephone lines; and materials of all kinds for lighting by electricity and gas. The packages or covers in which the articles named are imported are also to be free of duty, if they are prepared for the purpose. A reciprocity arrangement has also been entered into between Secretary Blaine and the British Minister, to embrace the British West Indian colonies of Jamaica, Barbadoes, the Leeward and Windward Islands, except Granada, Trinidad, and the colony of Guiana. It is expected that the arrangement will go into operation as to the West Indian colonies named on Feb. 1 next, and as to British Guiana March 31. Among the articles to be admitted free of all customs duty, and any other national, colonial or municipal charges, are India rubber, gutta-percha goods, telegraph wire, telegraphic, telephonic and electrical apparatus, and appliances of all kinds for electrical communication and for electric light and power purposes.

ELECTRICAL WORLD PORTRAITS.—NO. XXXI.

SIR WILLIAM THOMSON.

We present to our readers this week a portrait of the greatest living mathematical physicist—Sir William Thomson—whose recent elevation to the peerage in recognition of his long and invaluable services in the cause of science is a subject of congratulation throughout the entire scientific world. It is hard to estimate the genius of the man or the importance of his work.

Sir William Thomson was born in Belfast, Ireland, in June, 1824. His family, however, was of Scotch descent. His father, Dr. James Thomson, was a man of unusual ability and strongly developed mathematical talents, educated at the Glasgow University, and later professor of mathematics in the same institution.

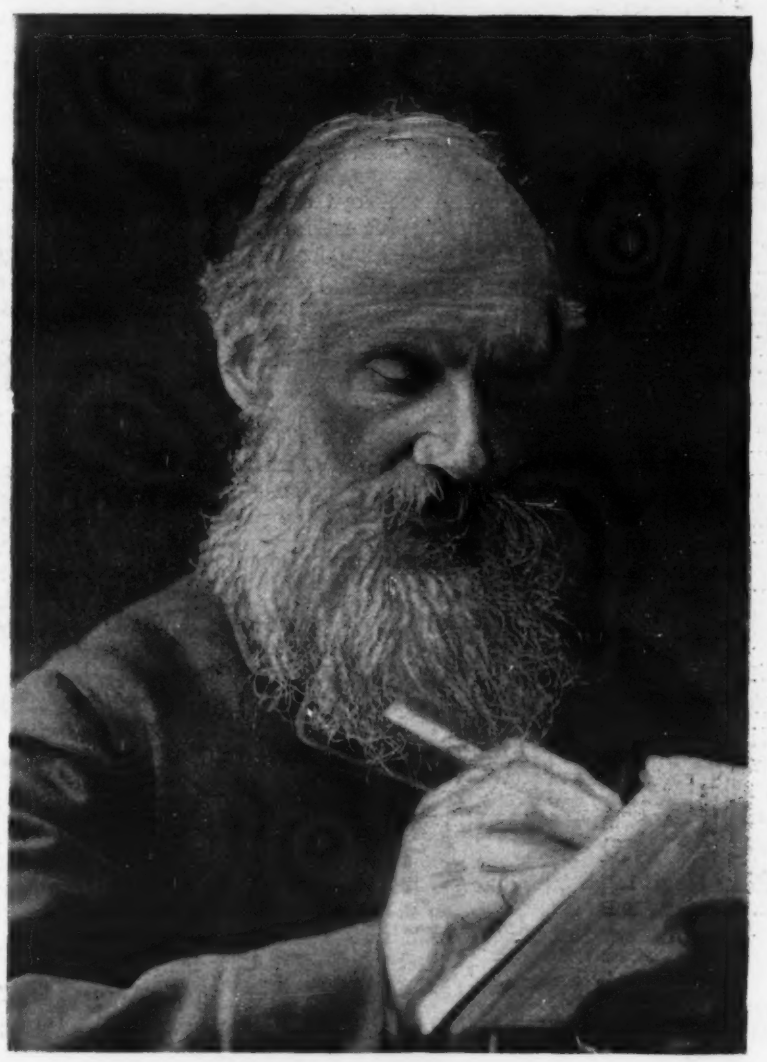
When William Thomson was eight years old his father moved to Glasgow to take the chair of mathematics in the University, and three or four years later William and his brother James, who has for many years occupied the chair of Civil Engineering in Glasgow, and who has himself taken a high position in science, studied together in Glasgow.

From Glasgow William Thomson entered St. Peter's College of the University of Cambridge, and was graduated as second wrangler in 1845, when he was but 21 years of age. He is one of a group of great men who have been second wranglers in that University. A few years more and the lamented Maxwell, Thomson's only peer in electrical science, was to be second wrangler in his college, and a little later yet Clifford, whose early death struck deep at the very heart of mathematical science, and still later Prof. J. J. Thomson, whose researches have attracted so much attention within the last five years.

During his university career William Thomson did not confine himself to his books to the exclusion of everything else. Music and athletics attracted him strongly, and he was not only president of the University Musical Society but one of the champion oarsmen of his time.

After his graduation he was elected a Fellow of St. Peter's College, and then entered on that magnificent scientific career that has lasted without intermission up to the present time, and bids fair to continue for many a year to come. In fact, even before that, his name had been heard in scientific circles, for in 1842, when but 17 years old, he had communicated to the *Mathematical Journal* a paper on the relation between the motion of heat in homogeneous solids and the mathematical theory of electricity, pointing out the analogy between the flow of heat and the flow of current, and showing how the same treatment could be applied to both subjects. In the same year another paper on the lineal motion of heat gave abundant promise of his abilities. In 1845 he began actively the study of electrical theory, and a paper on the elementary laws of statical electricity attracted instant attention to his work. It was followed the next year by the annunciation of his beautiful theorems regarding electrical images.

To follow the course of his brilliant researches at this



SIR WILLIAM THOMSON.

early time would be almost impossible in any limited space, for they literally fill volumes. His mathematical and physical papers fill three bulky volumes, besides another devoted to electricity and magnetism, and several volumes of popular lectures. All through these early days of his manhood he was working with the intensest activity, as the many papers of about this date in his collected works bear witness.

In 1846 Sir William Thomson was, at the early age of 22, elected Professor of Natural Philosophy in the University of Glasgow, a chair which he has filled continuously for 46 years, in spite of all efforts to draw him elsewhere.

A little later his attention was turned to the dynamical theory of heat, and his first paper on this subject was communicated to the Royal Society of Edinburgh in 1849.

He was quick to appreciate the vast importance of the experiments of Joule, and a few years later he undertook a long course of experiments in company with that distinguished investigator, whose lifelong friend he has been.

His first paper on thermo-dynamics was a critical review of Carnot's great work, and its applications to our modern ideas of heat energy. Soon the course of his investigations was led into thermo-electricity, and in 1855 was published his splendid paper on the electro-dynamic qualities of metals, which was made the Bakerian lecture for that year. During the progress of the experiments that led to this work he began to make use of his students as assistants, and about his personality grew up the physical laboratory of the University of Glasgow, the first real physical laboratory in existence.

But all this was only the beginning of Sir William Thomson's career, for, by 1855, a new field of investigation was opened, and his energies were turned in the direction that has proved to be intensely practical, although his methods appalled the practical electricians of his day.

The subject of ocean telegraphy was before the world, much talked of by the public, much debated by scientists. Michael Faraday was then in the very midst of his great career, and had been carrying on experiments showing the retardation of the electric current in conductors. Following up further this line of work Thomson investigated mathematically this very question of retardation, and when the possible success of the Atlantic cable came up Thomson's prediction of the retardation that would be experienced struck practical electricians aghast. They were very much inclined not to believe in this mathematical newcomer, and, indeed, one of the cable engineers read a paper attempting to refute Thomson's conclusions. But Sir William Thomson knew what he was about, and unmindful of the instinctive distrust felt by his practical contemporaries in his keen but somewhat gloomy predictions, set himself about the problem of finding apparatus which would overcome the difficulty which he knew must be encountered. When the 1858 cable was completed and ready to be tested the engineers struggled to make it operative with Morse instruments, and finding to their horror that they were unable to transmit even one word a minute, submitted to the inevitable, and the directors sent for Thomson to help them out of the difficulty which he had foreseen and for which he was even then prepared. The outcome of his investigations was the mirror galvanometer, which was successfully applied, its inventor accompanying the cable expedition and seeing it put into successful practice. Somewhat reluctantly, he was persuaded to patent the invention, the first of that notable series of instruments that have been the product of his practical ingenuity.

The first trials of this mirror galvanometer were early in 1858, and curiously enough the instrument was made by James White, of Glasgow, whose name is now familiar all over the world as the maker of Thomson's apparatus.

All through the experimental period of the Atlantic cables Thomson was active in pushing them to electrical success, and in 1867 he invented the siphon recorder, which two or three years later came into general use. In 1866 he was knighted.

Meanwhile his theoretical investigations were steadily in progress, but soon after 1872 other practical subjects engrossed his attention. One was the method of deep sea sounding employing pianoforte wire instead of rope; the other was the improvement and compensation of the mariner's compass. Both these inventions are of great practical importance and were brought out prior to 1876, since which time they have been in steady use.

During the last 15 years much of Thomson's time has been given to electrical problems, and during that period, besides investigating various theoretical topics, he has brought out that beautiful series of exact measuring instruments that are now in use all over the world, suggested the zigzag armature winding, and other improvements in dynamo-electric machinery, and has followed up with amazing keenness the progress of electrical science.

In 1876 Sir William Thomson was in this country, and served as one of the judges at the Centennial Exhibition. In 1880 he was at the International Exhibition in Vienna, and in 1884 he again came to America, to deliver a course of lectures on molecular dynamics at the Johns Hopkins University. These lectures treated mainly the dynamical theory of light, in which he was then a firm believer. His most abstruse and elaborate investigations on this topic have not yet been published, and the work of Hertz substantiating the electro-magnetic theory of light has lent to them new importance as furnishing a dynamical basis to electro-magnetic theory. The full publication of the 1884 lectures with later additions is promised soon, and it will be a most important contribution to science.

Sir William Thomson has received honorary degrees from a considerable proportion of the European universities; he is a Fellow of the Royal Society, President of the Royal Society of Edinburgh, Member of the Institute of France, Commander of the Legion of Honor, Past President of the Institution of Electrical Engineers, and member or officer of nearly all the important scientific societies in the world.

Sir William Thomson is as amiable personally as distinguished scientifically, and those who had the good fortune to hear his lectures in this country will recognize with pleasure the kindly, gentle face that greeted them as the great investigator led them through the intricate mazes of his work. He commands not only the admiration of the whole scientific world, but the affection of all who have come in contact with him, and that he may long be spared to continue the magnificent work that has characterized his long life is the most earnest wish of all to whom his name is familiar.

An Electric Interlocking Switch System.

Apropos of the subject of block signals which has recently been brought so prominently before the eye of the public, we show herewith a view of the signal plant that controls the great yard of the Pennsylvania Railroad in Jersey City. It is an excellent example of the application of the system of the Union Switch and Signal Company, which was described in our last week's issue. It stands rather apart from block signaling pure and simple, inasmuch as it is intended primarily to handle safely and expeditiously the enormous mass of railroad traffic that comes into that station by facilitating the control of the switches.

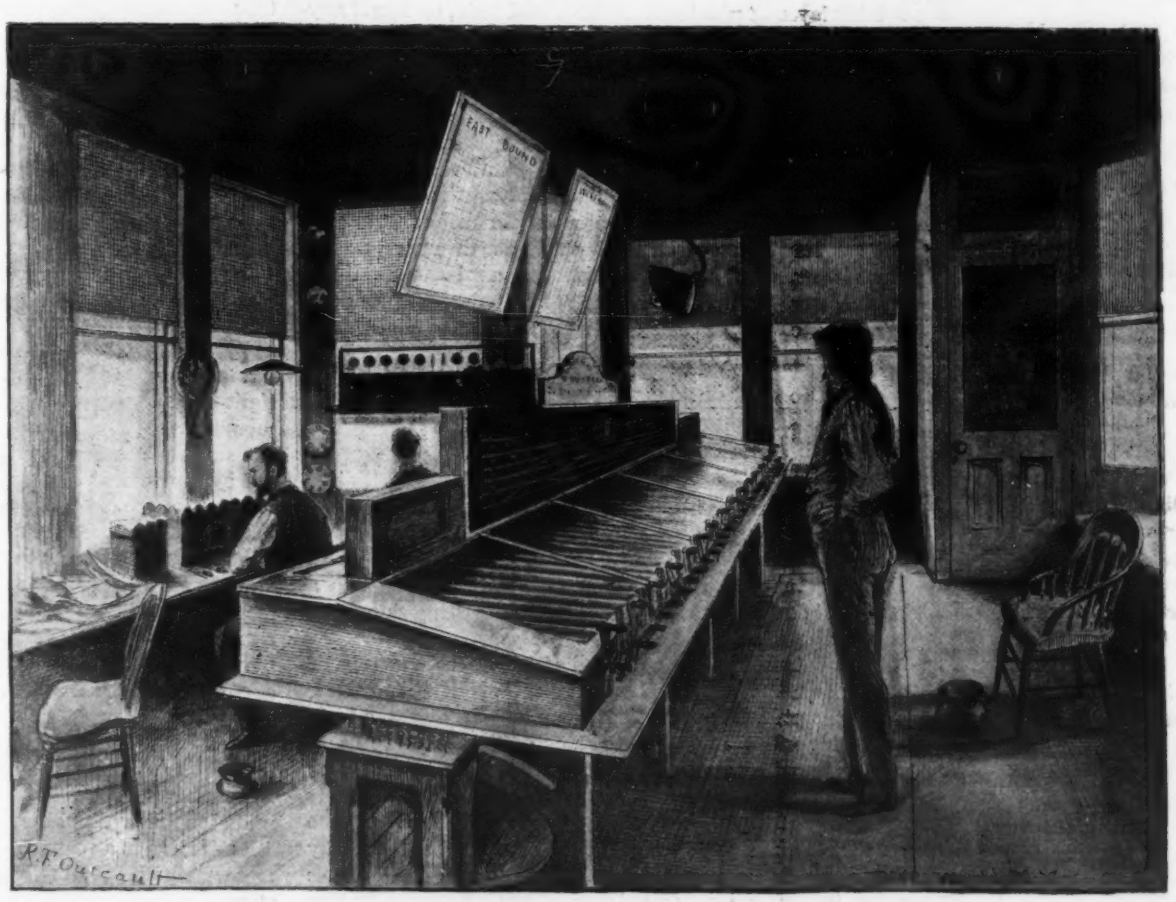
The main signal tower is within plain view of the station, and controls not only the yard signals, but every switch. The latter feat is accomplished by the very pretty electro-pneumatic switch instrument illustrated last week. The system of levers shown in the cuts looks exceedingly complicated; as a matter of fact, it is not, inasmuch as the complication is merely reduplication of parts. Every movement of the lever which throws a switch in the yard also throws the same switch in the model that rises before the eyes of the operator, so that a glance would tell the story if by any chance a mistake was made in the operation of the system. Of the levers in the main table, shown in the centre of the room, each controls a long switch cylinder that operates one of the pneumatic switch instruments located at some point in the yard.

Besides this switch and signal system there are subsidiary indicators to show the condition of the tracks in the station and at various points in the yard. The whole switch system is controlled by a single man, and it takes a peculiarly cool and level-headed operator to do the work satisfactorily. The other operators of the tower keep track of incoming trains and the condition of things at the station.

At the time of the strike on the New York Central something over a year ago a similar plant in the Central yard was abandoned by the operators, and some of the officers of the signal company had to come to the front and take their places, and a hard time of it they had too, attempting to handle on short notice the heavy traffic that comes into the Forty-second street station. Nevertheless the work was successfully done, thanks to the efficiency of the apparatus and the familiarity of the operators with its use.

It is almost impossible safely to conduct the operation of a great railway yard without some system of this sort, and although when first introduced the unfamiliar signals occasionally embarrass engineers and the operators have to become familiar with the system, it is only a few days before everything is running like clockwork, and no further trouble is encountered. The electrical power for working this plant in the Pennsylvania yard is obtained from storage batteries in the basement of the tower. These are charged by one of the dynamos in the station lighting plant, and have proved vastly superior to primary batteries in convenience inasmuch as a large amount of current sometimes has to be delivered in operating the numerous switches and signals. Two sets of batteries are in regular use, so that there is no danger of current failing at a critical moment, and the plant has given from the very start most satisfactory service.

It is a splendid example of the application of electricity to the safe conduct of railways, and is a credit both to the company that installed it and the enterprise of the Pennsylvania road in looking out for the complicated tracks at this new station in so thorough and efficient a manner.



INTERIOR VIEW OF A PENNSYLVANIA RAILROAD SIGNAL TOWER.

Automatic Block Signaling.

Inasmuch as recent accidents have added new interest to the problem of securing a system of signals that would insure the perfect operation of great railway systems without liability to accidents, THE ELECTRICAL WORLD has endeavored to secure some original views from men thoroughly informed on the subject.

Perhaps the most prominent signal engineer in the country to-day is Mr. Wm. P. Hall. As early as 1871 the Hall signal was used on the Eastern and the New York & Harlem railroads. The Hall of that day was Thomas S. Hall, termed the father of the American plan of automatic electric signaling apparatus for railroads. He was the father of Mr. Wm. P. Hall, who is now carrying on the business. This pioneer in signaling appliances turned his attention to this important subject as long ago as 1866, and when he died in 1880 his name was well known throughout the world in connection with railroad signals.

Mr. Wm. P. Hall has succeeded, after years of patient experiment and work, in developing his present system of automatic electric signaling, a brief description of which was given in the last issue of THE ELECTRICAL WORLD. Mr. Hall is unquestionably one of the ablest engineers in this line, and his views on the subject of automatic signaling given below are of great interest at this time. Speaking of the progress of the Hall signal on the New York Central Railroad Mr. Hall said:

"We installed a wire circuit system on the New York Central early in 1890. It was operated for two months under the five minutes stop rule, all trains being required to stop five minutes at each signal, as is the practice on some other roads. Under this rule the system was practically absolute. After two months, however, it was found that the length of the blocks and the volume of traffic were such that a one minute stop only could be made to insure the satisfactory movement of all trains. Under this one minute rule the difficulty arose of having more than three trains on the section at one time, and the limitation of the wire circuit signal being the protection of but three trains in a block at once. It was decided that a system of automatic electric signals to fully meet the requirements of their traffic should include arrangements for protecting any number of trains in a section at one time. This influenced us to develop a system which should cover the points I have mentioned and other minor objections to other parts of the system. Taking advantage of the opportunity thus offered the Hall Signal Company, we have perfected a new track circuit signal system which covers every essential point, and which has been recently placed in operation on a section of the Central road, and is now being thoroughly tested.

"The actual facts involved in the much discussed question of the adoption of the block system by the New York Central & Hudson River Railroad are not as fully known to the public as they should be, and the extraordinary zeal of the public press in denouncing what it terms the indifference of the railroad company on this subject seems to be about all that the public has been privileged to hear, with the exception, of course, of the statements of the road's officials. It gives me pleasure to state as one who is not connected with the road, and as representing the block signaling world, that in my opinion, judging from the facts in the case, the present management of the New York Central Railroad have been more than earnest and expeditious in their desire to secure and adopt such a system of signals as would insure the greatest degree of safety under the conditions of their traffic. For the past two years, since Mr. H. Walter Webb and Mr. Theodore Voorhees have had charge of the operating department of this great system, they have been constantly engaged in encouraging every promising plan of block signals in the market, in the way of expending large sums of money for tests, and in allowing extensive experiments to be made of various signal systems.

"Other officials of this company, among whom are General Manager Toucey, Chief Engineer Katte, Superintendent Motive Power Buchanan and Superintendent Hudson Division D. B. McCoy, have also been constantly investigating and consulting upon the subject and encouraging its development on their road. I am personally of the opinion that they have done more to develop the art of railway signaling for the benefit of the traveling public than many other railroad companies, and have ever shown a readiness to adopt and put in operation all meritorious and tried inventions that have been offered for consideration.

"I do not believe that the delay on the part of this company in installing the block signal system has been so much due to carelessness as to its endeavor to secure a more perfect system than those in use on other roads. As an instance of this I would state that the much praised system of the Pennsylvania Railroad, which the New York Central managers have been so universally criticised for not adopting, falls far short of insuring so high a degree of safety as it has been credited with. The Pennsylvania officials, of course, must be credited with the enterprise they have always shown in the adoption of safety appliances, but the management of the New York Central have certainly shown an equally enterprising spirit, if not more so than the former, for the reason that they have endeavored to take advantage of more modern and improved practice. Certainly nothing can be lost by an honest and conscientious effort to discover the best possible system for protecting the lives of their passengers, and this, I am confident, is the spirit which actuates the New York Central management. As a fair illustration of this fact I might state that they have now under test on different parts of their line three different signal systems, of which the good points of each, no doubt, will be adopted if they meet the requirements of the company."

J. B. Stewart, superintendent of telegraph and signals of the West Shore Railroad, was asked his opinion as to the use of various signal systems. He stated that his road has had a manual system, or what is more properly known as the plain English block system, working for some time, and it has given good service. Speaking of the automatic system and its advantages, he said:

"I thoroughly believe in the automatic system of signaling, for the reason that it will protect, as I understand it, the whole train from the time it enters the block until it leaves it. If you have a track circuit electrically connected with the signals, the train will operate the section and thus protect itself, for if one pair of wheels connected together by an iron axle shall enter the section, it is sufficient to cause the signal to go to danger at once. I do not know of any other arrangement by which a train leaving some of its cars within the block could be protected. That is to say, it frequently happens that a train parts and the engine goes forward with part of the train and passes out of the block. The operator who handles the manual system must watch for the colored lights on the last car. If he should neglect to do this, and report the train as having passed out of the block, the next following train would receive a clear signal and find the rear portion of the preceding train still on the block, thus causing a collision. If a train should part on an automatically protected system, the signal in the rear of the train cannot clear, because, as I have said before, one pair of wheels is sufficient to hold the signal at danger. I believe that the method of clearing the signal as the train approaches is the best and is according to the practice of all manual systems in use to-day. With such an arrangement the engineer can see the signal operate and will know that the track ahead is clear and that his train is protected. Under the systems in use on the Erie, Pennsylvania and New York, New Haven & Hartford, they have to depend on the operator to see that the last car of a train passes out of the block. The New York, Ontario & Western Railroad when it operated the east end of the West Shore, used the pneumatic system for about seven miles when it first commenced operations. When, however, the West Shore took charge of the road, it was found that the system was causing very great and unnecessary stops, and it was abolished in favor of the plain English block system, which was then installed. Since that time improvements have been made in the pneumatic system, and it is now in use on the Pennsylvania, and for a short distance on the New Jersey Central, but only where it can be used in connection with switches.

"The pneumatic is the most expensive both in first cost and cost of maintenance, while the automatic electric system with track circuit is comparatively inexpensive to install and its cost of maintenance very much less.

"With manual systems we have, of course, to depend on human agencies and experience demonstrates that to 'err

's human.' I believe the electric automatic system having the signals connected and operated by a track circuit is the safest one possible. At the same time I believe that the Sykes system is the best manual system known in practice to-day, because two men will have to make a mistake before a wrong signal can be given. I would like to say that the system employed by the New York Central Railroad south of Poughkeepsie meets the conditions of the service on that division, for the reason that trains of an inferior class must be switched out of the way for trains of superior class to pass, and that men must be employed to throw the switches and signal other of these trains when it is necessary to sidetrack them. To meet these conditions I believe the system installed is the right kind of arrangement, that is, interlocking their crossover and sidetrack switches with their main line signals. This plan will not only facilitate movement of trains, but will secure absolute safety. The conditions on other parts of the road are different, and it is not necessary to have the operators act as switchmen.

"I have examined the Hall track circuit automatic signal system, and if I owned or controlled a railroad I do not hesitate to say that I would feel perfectly safe if my trains were protected by it.

"I would consider a combination of the manual and automatic systems desirable for the reason that where you have crossover or sidetrack switches they can be handled by the operators in charge while the intervening block or blocks could be protected by the automatic, interlocking arrangements, however, to be connected with the automatic in such a way that the operator could not give a clear signal if the automatically controlled part of the track was occupied by a train."

A Portable Photometer for Measuring Street Lights and Illumination in General.*

BY CARL HERING.

Some time ago the writer was called upon by a committee of councilmen from a town in this State to settle a dispute regarding the candle power of the electric street lights, for which the town had contracted with a local electric light company. The company had contracted to furnish a certain number of incandescent street lamps of 25-c. p., but after a year's trial the town authorities thought that the electric lights at 25 candles were not as bright as the gas lights at 12 candles, and they concluded that they were not getting what they paid for. The matter was referred to the writer to measure the actual candle power of the lamps throughout the town, and make a report on their candle power.

The electric light company suggested that the lamps be taken from the poles, brought to the electric light station and measured there by means of the ordinary photometer. Although this simple method appeared satisfactory to the councilmen, it was not so to the writer, for obvious reasons, which any electrical engineer would appreciate. It was concluded that the only satisfactory way was to measure them while on the poles, on different days, at different times of the evening, and without the knowledge of the company as to the days or hours when they were to be measured.

This required the construction of a portable photometer, which had to work equally well in all kinds of wind and weather. It had to be light and small, so as not to attract attention, in order that the electric light company should not know that the lights were being measured, and take unfair advantage of the opportunity to run up the lights. It was furthermore necessary that the results should be quite reliable, as the matter might have to go before the courts.

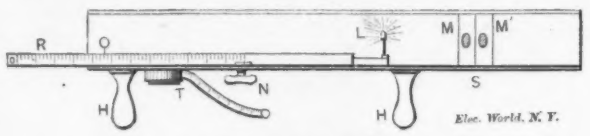
The conditions were, therefore, very difficult to comply with. One of the chief difficulties was to get a standard light which could be used out of doors in a portable photometer. To use a standard candle was out of the question. Its light varies with the temperature, it often requires trimming, and it would be almost, if not quite, impossible to prevent the wind from affecting its candle-power; for it is well known that even a person moving around in a photometer room will make sufficient disturbance of the air to change the candle power of a standard candle. Besides, a standard candle at its best is a very poor standard. For this and other reasons it was decided to try to use the Hefner-Alteneck amyl-acetate lamp. This lamp, as is well known, burns a liquid which is constant in its composition, that is, it does not contain varying quantities of more or less highly combustible materials, as benzines and coal oils do. All the dimensions of the lamp may be duplicated with great precision, thus enabling the whole standard to be duplicated with greater precision than a standard candle. If the flame is kept at a certain fixed height, by means of a gauge and a wick-screw, the light will remain constant. The original proportions were determined by its inventor by very exhaustive experiments made under the most favorable conditions with the standard candle, so that this lamp may be taken as representing a very fair mean of the average values of standard candles.

In constructing the photometer it was at first attempted to use this standard lamp in the portable photometer itself. It was suspended on a pivot, so that it remained vertical when the photometer was inclined, the axis of the pivot passing through the centre of illumination of the flame. The lamp was inclosed by concentric cylindrical tubes, with openings at the top and bottom, so that the wind, from any side, would not affect the draught or the flame. Lights were so arranged that the height of the flame could be adjusted without opening the inclosing case. But, notwithstanding all the precautions taken, it was found that the flame burned differently when in the wind-protecting box; and this lamp was therefore discarded as unreliable when used out of doors.

The next device tried was to take a portable outdoor lamp, such as is used by night watchmen, having a broad, flat flame, and place on one side of it a black screen, with a hole in it just opposite to the whitest part of the flame. As this part of the flame may be taken as remaining constant for all slight changes in the height, size or flickering of the flame, the light passing through this fixed aperture may be taken as constant and steady. The oil used was amyl-acetate, the same as in the standard above mentioned. This was found to work well in a room and when the photometer was held horizontally, but when used out of doors, or when tilted slightly, it was found that the glass or mica, shielding the flame from the draught, became turbid or blackened, making a very great change in the amount of light transmitted through it. It was noticed also that the flame, like that of a standard candle, appeared to get smaller and less bright in the cold air. It was, therefore, also abandoned.

There seemed to be nothing left but to use an electric light supplied by a portable accumulator. This was tried and was found to be perfectly satisfactory. The lamp used was a small four-volt incandescent lamp of about 1 c. p., requiring a current of slightly less than an ampère. The accumulators consisted of two cells placed in a wooden box having a shoulder strap, enabling it to be carried by the operator at his side. The weight of it complete was about 20 pounds. The cells were sealed with lids before the acid was added, and the whole was covered with a thick layer of powdered carbonate of soda, so that if any acid did come out through the vent tubes it would be decomposed and then evaporate.

As the voltage of an accumulator will become less and less as it is being discharged, it would change the candle power of the light very materially. To get over this, the accumulators were chosen of such a capacity that the amount of current used in one set of tests was only about one-fiftieth of its capacity; the fall in potential for such a small discharge may be taken as negligible. Furthermore, as the light was turned on for only about half a minute at a time, with intervals of rest of five or ten minutes, the cells had time to recuperate. The cells were discharged slightly before the test, in order to bring them down to their normal and constant voltage. Comparisons of this light with a standard during different parts of the evening showed it to be quite reliable and constant.



Hering's Portable Photometer.

The photometer itself consisted of a light wooden tube of square cross-section, 4 inches to a side, about 3 feet long and open at both ends. The above figure givess a view of it with one side removed to show the inside. The usual screen *S*, with a grease spot, and mirrors *M M*, was placed near the right-hand end, and a square opening left in the side of the tube opposite to it to look through. The tube was blackened inside and outside with a paint made by mixing much lampblack with a little very dilute shellac. This paint, in drying, leaves no gloss. It was supported by two projecting handles *H H*, the right hand one being nearly under the centre of gravity, so that the whole could readily be supported by the right hand alone. The small electric lamp *L* was secured to a block capable of being slid along inside of the tube by means of a projecting rod *R*, having a scale attached (as shown), which indicated the distance of the lamp *L* from the screen *S*. This rod, with the lamp, could be securely clamped at any desired distance from the screen by a thumb nut *N*. A 15-feet tape in a spring case *T*, without pawl and ratchet, was attached on the bottom near the left handle. A small switch (not shown) for turning the electric light on and off was also secured near the left handle.

To use the photometer it must first be standardized. This is done in any convenient room which can be darkened. The instrument is laid on a table with the standard Hefner-Alteneck lamp above mentioned, which is placed at a fixed and known distance opposite the right hand end of the photometer tube. The small electric light is then turned on, and moved forward or back, until the grease spot seen in the mirror M^1 on the *right hand* side of the screen *S* disappears altogether. The left hand side (toward the small electric light) was not considered at all. This adjustment, therefore, admits of considerable precision, as there is no difficulty in making the grease spot disappear on either one side or the other; the difficulty is in making it nearly disappear to the same extent on *both* sides, and it is here that the large personal error enters in ordinary photometric work, in which no two operators will set it alike. After making this adjustment the electric lamp is firmly secured in that position and the photometer is ready for use.

To use it in measuring street lamps, or any other source of light, the right hand end is pointed toward the light in either a horizontal, a vertical or an inclined direction; the small electric light is then turned on, and the whole tube moved toward or away from the light to be measured until the spot of light again disappears on the mirror M' to the *right* of the screen *S*. By measuring the distance between the screen and the light to be measured, and knowing the calibrated value, the candle-power of the light is readily calculated from the well known laws. The distance from the screen to the large light is measured by means of the spring tape *T*, which passes directly under the screen, and may be easily read by the operator. The small switch placed near the left hand handle (not shown in the figure) enables the current for the small lamp to be turned on and off readily, so as not to burn it longer than just enough for the test.

It will be noticed that in this photometer only the mirror on one side of the screen *S* need be observed, not both, as is usual. The grease spot may therefore be made to disappear entirely, which admits of an adjustment more accurate and decided than the usual method. It is for this reason that this photometer is even more accurate than the usual one in which the balance is produced on both sides of the screen. The candle power of the small light, as well as its distance from the screen, need not be known or measured; they must merely remain constant. This light merely serves as a constant secondary standard of light which will at all times reproduce the same illumination of the screen as that produced and balanced by the real standard during the calibration. In other words, it forms an adjustable and portable unit of *illumination* of the screen as distinguished from a unit of *light*.

It is evident that this unit of illumination should be so chosen as to suit the light to be measured, otherwise the tape required to measure the distance might have to be impracticably long; and this should be taken into consideration in choosing the distance to the standard lamp in calibrating the photometer. For measuring very bright lights the standard should evidently be brought near to the screen *S*, so as to make the unit of illumination greater. In the measurements above mentioned the lights to be measured were from 10 to 25 c. p., and it was thought that from 4 to 6 feet of tape was a convenient distance, being an average of about 1½ inches per candle. This would require, as a unit of illumination of the screen, a little less than one foot candle. For convenience in making calulations the standard was placed at 14⅛ inches ($= \sqrt{200}$) from the screen in the calibration. This gave such a unit that the square of the distances in tens of inches is double the candle power of the light to be measured, a calculation which is readily made mentally, approximately at least. A difference of one candle power in the unknown light would, therefore, require a movement of the photometer of about 1½ inches; a fraction of a candle may, therefore, readily be detected: hence the photometer was quite sensitive for this class of work. The end of the tape was held up to the centre of the lamp by an assistant with the aid of a pole. The spring case of the tape kept it stretched so that the tape was virtually a fixed rule or scale, over which the whole photometer was moved. The right hand end of the tube must be long enough to shield the screen from the light of other lamps, or of the moon.

This form of photometer has the further advantage that it can be used to measure "illumination" as distinguished from the candle power of a light. For instance, the illumination on a desk, for reading or writing, the diffused illumination in a room, the light from a north window, or from a chandelier, daylight in general, moonlight on the streets, sunlight, etc., cannot be expressed in candle powers; they must be measured in units of *illumination*, the unit being the illumination produced on a surface placed at a distance of one foot from a standard candle. In measuring such illuminations, the distance from the screen of the photometer to the source—as, for instance, in the case of daylight—as will be seen from its nature, an immeasurable quantity.

To use this photometer for such measurements, the right hand end of the tube is made in such a way that it can be taken off, so that the grease spot screen forms the end of the tube. The photometer is calibrated, as before, but instead of securing the rod containing the little lamp, its position should be read on the scale shown in the figure, the zero of this scale being such that the reading gives the distance of the small light from the screen. Being thus calibrated, it is ready for use. To use it, as, for instance, to measure the illumination on a desk produced by daylight, the photometer is placed vertically, so that the screen is on a level with the desk, and the electric light is moved in its position until the grease spot disappears. From the reading of this position, and that of the calibration, the illumination in foot candles is readily calculated. From this the number and position of electric or gas lights, necessary to reproduce such an illumination, may then readily be calculated.

For measuring daylight the auxiliary electric light used must be very much brighter than before, at least 16 candles, and preferably more. As the electric light is very yellow compared to day light, it is not so easy to make the grease spot disappear entirely; but this is no serious objection, as great accuracy is not necessary in such measurements.

*From the Proceedings of the Engineers' Club, of Philadelphia.

Pictorial Telegraphy.

BY A. P. TROTTER.

I observe that Mr. N. A. Amstetz, of Cleveland, O., has invented a process for transmitting pictures by telegraph. As I have given some attention to this subject and have read the description of his method with interest, I venture to offer some suggestions based on my own experiments. When the *Daily Graphic*, of London, issued a preliminary number about two years ago, I noticed a statement to the effect that the time had not come when the special correspondent could be placed in connection with the newspaper office in such a manner that sketches could be transmitted. This statement led me to consider the problem and I worked out the details of an instrument for solving it. After making some preliminary experiments I found that there was no demand for such a process. London journalists of considerable experience, though at first interested in it, considered that there was no practical value in the thing. As however it may be that the conditions of telegraphy and of journalism are sufficiently different in the United States to make it worth while to transmit pictures by telegraph, my experience may be worth recording.

The principle of Caselli is, of course, well known to all students of electrical applications, and I have had an opportunity of examining several instruments of this kind at work; more than one was in operation at the electrical exhibition at Paris in 1881. At this exhibition there was shown by Christofle & Co. a machine for engraving ornaments, the tool being worked by an electro-magnet, and the design being drawn in non-conducting ink on a sheet of metal. It occurred to me that these two methods might be combined, and that a type-high block of type metal might be engraved, and turned out ready for printing. It would be impracticable to remove enough metal from the "whites," and I proposed to leave a ground of a light tint, the picture being in black upon it. The best plan, but one upon which I have not experimented, would be to drill or punch a number of round holes, leaving little dots between. The dots of a Meissenbach block of a fine quality run about 100 to the linear inch. If a number of circles 0.012 inch in diameter be placed in rows at a pitch of 0.01 inch, they will leave between them little square shaped figures about 0.002 inch wide. If such circles be formed by drilling conical holes in a block of type metal, the surface will give an impression similar to a good Meissenbach. The general idea of the receiving apparatus then would be a machine, which would when once started drill row after row of such holes; the mechanism consisting essentially of two portions, the drill and the feed. If the drill missed fire a black dot 0.012 inch in diameter would be the result. If the drill missed a number of holes, a line of dots running into each other would be produced. The printing block and the original design, drawn in non-conducting ink on a metal plate, being set to move synchronously, on the Caselli system, it would be only necessary to cause an interruption of the current to make the drill miss a hole.

Mr. A. Stroh, to whose ingenuity the perfecting of the Wheatstone automatic instrument is due, was good enough to give me much valuable and interesting information about the speed of working. From him I learned that the levers of a Wheatstone can be made to move at the rate of 200 strokes with 400 reversals of current per second. This corresponds to a speed of 428 words a minute, and one which is often attained on English Post Office lines. At the Kings College laboratory is kept the mirror with which Wheatstone measured the velocity of propagation of electricity, and which was rotated with a speed of 800 revolutions per second. This is such a large and ill balanced piece of apparatus that there would be no difficulty in driving the drill at about 500 revolutions per second. This would allow one and one-half revolutions for the drilling of each hole, allowing 100 per second, or half the speed of a Wheatstone automatic. I have devised several methods for depressing the drill, the simplest being on the principle of a boiler shop punch, which continuously works up and down, but does not make a complete stroke unless a wedge is inserted behind the punch. The armature of a magnet moving about three-hundredths of an inch would suffice for determining the stroke of the drill in this manner. It being important to use only one line for the transmission, the synchronizing could best be effected by an alternating current, operating polarized magnets. The positive currents would drive a motor synchronizing on the La Cour system as used by Delany, and the drill would be operated by the negative currents. Instead of a continuous pressure of a contact on the picture to be transmitted, a reciprocating contact maker might traverse the original sketch, making contact or not when depressed, and sending a negative current; and always sending a positive current when raised. Various mechanical modifications of this idea present themselves to any one accustomed to mechanism.

Before proceeding to construct such a machine, I thought it best to make careful inquiries as to its probable value in practice, and as no one will look at a bundle of working drawings I began to experiment with a view to produce some blocks which would at all events give a good idea of the result which may be expected. To avoid the difficulties of the drill, I fell back on the Caselli principle of a broken line. For English newspaper work, the success of the invention would depend on the saving of two or three hours. No process in which photo-etching or electrotyping was required would be any good. It would be necessary to produce a block perfectly ready for the press or for the stereotyper. For that reason my designs have been for a machine to engrave a flat block and not a cylinder. I experimented first with various kinds of metal. Lead is out of the question, since shavings do not break off, and a burr is formed at the end of each cut. Type metal is unnecessarily hard. Stereo metal, or electro backing metal, proved to be excellent. The shavings generally break off, and even if not blown away, lie so lightly on the plate that they do not interfere with the tool. Careful examination of process blocks showed that a pitch of less

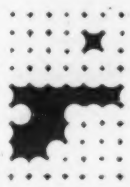


FIG. 1.—ENLARGED VIEW OF IMPRESSION FROM A DRILLED BLOCK.

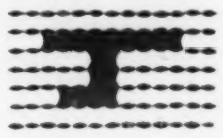


FIG. 4.—ENLARGED VIEW OF IMPRESSION CUT WITH VIBRATING TOOL.

than one hundred to the inch does not deceive the eye sufficiently, while anything much finer than that would be too delicate for fast newspaper work. I made many experiments on the best form of tool. At first I attempted to cut in one direction only, coming back with a quick return. A tool very like an ordinary flat drill, consisting of two edges making an angle of about 60, worked very well, and afterward, these edges were sharpened up to knife edges, forming a sword point, Fig. 2, which cut in both directions. I used steel wire of 50 millimetres, tempered straw color, and carefully set. These would cut four or five square inches without serious blunting.

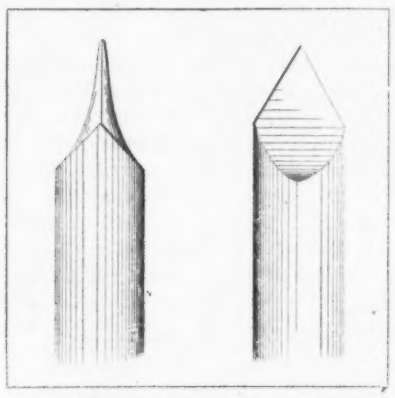


FIG. 2.—ENGRAVING TOOL.

The depth of the cut is a trifle less than its width, and many experiments were made to find the best depth, with the determined width of printing surface left between each cut. A defect in the Caselli system appears when the lines of the picture run nearly in the same direction as the lines of the reproduction. In order to aggravate this as much as possible, a block was engraved to show this at its worst. At the same time, different depths of cut were tried by packing the block on one side, so that at the commencement of each cut the whole of the printing surface was cut away, leaving knife edges of type metal, and the cuts ran out to nothing on the other side. This block

FIG. 3.—DRAWING REPRODUCED BY ELECTRO-MAGNETIC ENGRAVING MACHINE.

happens to be the only tolerable one left in my possession, the others being given away as curiosities. The following illustration (Fig. 3) is printed from an electro. On one side may be seen the result of a light cut.

It should be clearly understood that this block was engraved, not by telegraph, but only by an electro-magnet toolholder, the arrangement being similar to that of Christofle. The original sketch was drawn in India ink on a sheet of tin plate, the surface being scoured with emery, which allows the ink to flow very freely. The drawing and the printing block were mounted together on a slide, and the feed was given at the end of each stroke by a pawl, ratchet wheel and feed screw. The tool was depressed by a magnet, taken from an electric bell. Four Leclanché cells coupled in pairs were used, and the armature was arranged to pull the tool firmly down, leaving a fair margin of force to spare. A rubber spring pulled the tool up when the current was broken by the India ink. If I remember right, this block was cut in one direction only, the cuts following each other at the rate of about one hundred a minute. The return stroke was only a little quicker, and the tool speed may be put at about 25 feet per minute. Cutting in one direction only, engraving could be accomplished thus at the rate of two square inches per minute, at a speed corresponding to the transmission of about 200 words in the same time.

Although the present block may be said to be promising, it clearly shows that even a tint composed of knife edges at one hundredth of an inch pitch is too dark for a background to a sketch, and if the pitch be made wider, the result will be much coarser. I am of the opinion that the Caselli system applied to block engraving can only be made useful by giving a vibratory motion to the tool, so that, by the intersection of two cuts, a tint of dots instead of lines may be left. This might be done mechanically, the effect of the current being merely to determine whether a cut should be made or not.

Since nearly all daily newspaper illustration is produced by line blocks such as woodcut or plain zinco process, the tone blocks of the Meissenbach and similar processes being too shallow and delicate for the work, I have not attempted to reproduce tone, nor do I think that it will be worth doing until long after black and white drawings are successfully transmitted. At the same time I have experimented with a purely mechanical process on the principle employed by Mr. Amstetz, with the object of producing a tone block from a photograph, and I think that the method has some advantages.

A modification of the engraving process which I have briefly described suggests itself, viz., to cover the block with an etching ground which would be cut away by the tool. This would allow the whites to be deepened by acid. If an hour or so could be spared, a fairly deep block might be produced. I have tried to punch a number of holes, instead of drilling them, using lead for the purpose. Of course a burr is raised round each hole, but when a large number are formed in regular rows, a very fair tint is produced. One disadvantage is that the blacks are left at a slightly lower level than the tops of the burrs. A very considerable blow is required to make a round hole with a conical punch. It would have to be done mechanically, and the current would merely determine whether a blow should be given or not. A few experiments were made with currents of different strengths, but with the sharpest tool and the most careful setting the width of the cut was very uncertain, and did not correspond at all accurately with the strength of the current. In wax, a different result might be expected. For metal, it is best to pull the tool home, with some little margin of force to hold it against a stop.

I have chiefly confined my remarks to the results of actual experiments which were preliminary to telegraphy, but I found no encouragement sufficient to warrant the expense of the complete apparatus, and I have not, therefore, tried any synchronizing arrangements. I am satisfied, however, that the La Cour system would suffice for one cut, and an opportunity of starting fair would be given at the beginning of every fresh cut. I propose to reverse the carriage on which the block is mounted, and to feed it laterally by means of a continuous current of considerably longer duration than the working currents, say a quarter of a second. This would work a magnet which would not respond to the working currents. I do not think it is advisable to make use of currents of different strengths, since the system could not be worked on long lines by relays in the usual manner.

The main details of the system and the necessary mechanism were worked out on paper immediately after the issue of the preliminary number of the *Daily Graphic*, and on Dec. 9, 1889, I filed a provisional specification No. 19,794 at the Patent Office, and went thence direct to the office of the *Daily Graphic* to see Mr. T. Heath Joyce, the editor, with whom I had made an appointment. He would open no negotiations until specimens could be produced. This led to my experiments, but these were eventually given up when I had satisfied myself that the thing could be done, and had found out that no newspaper really cared to take it up. The *Daily Graphic* has not revolutionized English journalism. More than half the illustrations could be, and probably are executed with no hurry whatever. On the other hand, a glance down the columns of a daily paper suggests very little that could possibly be illustrated. If anybody wants to telegraph pictures it can be done, but it seems to be a mere scientific curiosity like the photophone.

Dynamo Characteristic Curves.

In a short article recently published, Mr. Lucas makes the following interesting statement: If the characteristic equation of one type of a dynamo does not contain more than three constant characteristics, the characteristic curves of different machines of this type may be deduced from one another by a simple changing of the scales of the abscissas and ordinates.

We give this here merely to call attention to it. Those who are interested in the proof of the statement and any further information regarding it are referred to the article on page 506 of *La Lumière Electrique*, Dec. 12,

The Meaning of the Term "Inductance."

BY THORBURN REID.

I notice that the English electricians are discussing the question of what meaning shall be given to the term "Inductance," first suggested by Mr. Oliver Heaviside and which has been quite extensively used since then by electricians in this country as well as in England, no doubt on account of its exceeding shortness and aptness. Mr. Heaviside suggested the name to denote the quantity ordinarily represented by L, or, as it used to be called and is still to some extent, the coefficient of self-induction. But by reason of the rough usage that such exact definitions often receive at the hands of the "practicians" (another very expressive word coined by Mr. Heaviside), it is now often, if not generally, used to denote an entirely different thing, and that is the quantity represented algebraically by $2\pi nL$ where n represents the frequency of an alternating current.

That the word will have one of these meanings I think is not to be doubted, and the question to be settled is, which shall it have?

When the word was first suggested, I seized upon it and used it with the meaning given it by Mr. Heaviside, but soon found an increasing annoyance in the use of the cumbersome expression "$2\pi n$ times the inductance," and I then shortened that into the "inductance factor." Finally I interchanged the two meanings, expressing the quantity $2\pi nL$ by the word inductance, and L itself I called the inductance factor.

There are advantages in this both practical and theoretical. In the first place, the practical engineer or practician seldom has any occasion to use the inductance factor unless it is multiplied by $2\pi n$. I think I may safely go farther and say that in the present stage of electrical manufacture he never has to use it thus except in the algebraic work of deducing the equations he has to employ, and if he does that himself he is much more theoretical than ninety-nine hundredths of the practicians I have met. In the next place, impedance, which, Mr. Swinburne to the contrary notwithstanding, is universal and indispensable in alternating current calculations, contains two factors, the one the square of the ohmic resistance, the other the square of $2\pi nL$. What more natural than by analogy to call this second term inductance and say that impedance is the square root of the sum of the squares of the resistance and the inductance?

There is also a strong theoretical reason why L should be called the inductance factor rather than the inductance, and that is that even when it is not multiplied by $2\pi n$ it is always multiplied by something before it is of any use. It was originally called the "coefficient" of self-induction, which name was apt enough but too long and cumbersome for every day use, and the meaning of the expression "inductance factor" is exactly the same and it is very much shorter.

One complication occurs to me, that the henry, if I remember rightly, was defined as the unit of inductance, and as no one would recommend the changing of that unit to represent anything else than the quantity denoted by L, its meaning would have to be redefined and the new definition might be a little awkward in expression, although it can be easily made perfectly clear in meaning.

If these expressions are adopted we may speak of a piece of apparatus as having an inductance factor of so many henrys, and the inductance at any frequency is then obtained by multiplying the inductance factor of the apparatus under consideration by 2π times the frequency.

I have not entered deeply into the question of what future developments in theory or practice may demand, but I have simply given the usage found convenient in my work, in the hope that others working in different fields who may have found the same or some other usage convenient may offer suggestions which will make a final decision in the matter easier and more likely to be the best possible.

Elements of Practical Electricity.*

BY DR. LOUIS BELL.

Having obtained an idea of the units of electromotive force, current and resistance, and of the applications of Ohm's law, it may be well to go back a little and look into the question of resistances in parallel and in series.

Some time ago you constructed five resistance coils. At the time you were not familiar with the units of resistance and no definite value was assigned to these coils. As a matter of fact, however, coil No. 1 was half an ohm, Nos. 2 and 3 an ohm each, and Nos. 4 and 5 two ohms.

By reference to the table given in the last section of this article you will see that coil No. 1 consisted of 50 feet of No. 20 wire, which has a resistance of a trifle over 10 ohms per 1,000 feet, consequently its resistance was one-twentieth of 10 ohms, or half an ohm. The resistances given in the table are those of pure copper wire. Now the majority of the wire in the market, and which is likely to fall into your hands, is not entirely pure, and its resistance is one or two per cent. greater than that given in the table. This was partially allowed for in cutting the lengths of wire for your resistance coils. You have therefore at your command 6½ ohms, and, by joining your coils together in various ways, can get any combination of resistances you require by going from zero to 6½. For example, you have a one-ohm coil and a two-ohm coil, joined in series these would give you three; four ohms you can get from either the two-ohm coils in series, or one of the two-ohm coils and both the one-ohm coils; five ohms by putting the two two-ohm coils and the one-ohm in series; six ohms by putting both twos and both ones in series, and, finally, to any of these in series you can add the half ohm.

RESISTANCES IN PARALLEL.

Now, what can be the effect of joining some of these resistances in parallel? That it reduces the resistance you have already seen; how much it is now our purpose to inquire.

One can naturally look at the ability of a wire to transmit current in two ways, first, that it is of a certain resistance, second, that it is of a certain conductivity. Halving the resistance obviously doubles the conductivity, and halving the conductivity is the same as doubling the resistance. In other words, conductivity is inversely proportional to the resistance; as it increases the resistance decreases and vice-versa.

Now, having obtained the unit of resistance, we can also set up a unit of conductivity, which will prove immensely convenient. We can do this by simply looking at the resistance from another direction and seeing that a wire of unit conductivity is one through which one ampère will flow under one volt pressure. In other words, a wire having a resistance of one ohm is of both unit resistance and unit conductivity. A wire of two ohms' resistance has a conductivity of one-half, and of half an ohm resistance a conductivity of two. So, in general, we can get the conductivity of a wire by taking the reciprocal of the resistance; in other words, divide unity by the resistance in ohms.

Now, join up in parallel the one-ohm coil and the two-ohm coil, and let us see what will happen when a Daniell cell is connected to them. It has an electromotive force of about one ohm. Evidently the electricity is free to flow through both the coils, and with respect to the total current the ability to transmit it is added, the one ohm coil has a conductivity of one, the two-ohm coil of one-half, therefore the combination has a conductivity of three halves, or, inverting the fraction two-thirds of an ohm. Under the given electromotive force an ampère will flow through the ohm coil and half an ampère through the two-ohm coil, as can be seen by applying Ohm's law to each separately. And in general, whatever the number of resistances joined in parallel, each one will take an amount of current exactly proportional to its conductivity, and, therefore, inversely proportional to its resistance, providing the electrical pressure is kept constant at the terminals of all the coils. You will observe, too, that the fall of potential in all the coils connected in parallel will be the same, for E always equals CR, and as R increases C decreases in precisely the same ratio.

You can now extend these principles to the consideration of any number of resistances in parallel. To find the resistance of a combination you have only to find the conductivity of the combination and take its reciprocal. For example, supposing you were to connect in parallel coils of one, two, three and four ohms resistance, what would be the resistance of the whole? The conductivity of the whole is equal to the sum of the conductivities of the separate parts themselves: $1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}$; by adding these you will see that the conductivity is 25-12ths, the resistance is, therefore 12-25ths of an ohm. And so you can go on to find the combined conductivity of any number of conductors of known resistance.

You will do well to remember one important fact in connection with this matter, that when you connect resistances in series you add their individual resistances; when you connect them in parallel you add their individual conductivities. This covers the whole matter.

INTERNAL RESISTANCE.

In this same connection there are some important considerations connected with fall of potential—drop in electrical pressure, if you like. We have already seen that it is always equal to the current times the resistance. Now, supposing you connect a large number of resistances in series and pass a current through them, the same current flows through all, therefore the fall in potential is proportional to the resistance, as we have already seen in considering another matter. Suppose, for example, you wanted to obtain the electromotive force of half a volt: connect one of your Daniell cells through your two one ohm coils in series with each other, the current flowing through both is half an ampère, the fall in potential between either terminal of your battery and the point where the two coils are joined is therefore half a volt, so that you at once have at your command the half volt pressure that you wanted.

You must not forget, however, in all this that your battery itself has a resistance, so that the exact figures given are only approximate. They would be very nearly true for a very large battery having therefore a very small internal resistance. In most cases, however, you cannot neglect for purposes of exactness the internal resistance, which is to be treated precisely as any other resistance in circuit.

If it were possible entirely to neglect the internal resistance of the battery and consider only the resistance outside of it, it is evident that you would be able to obtain the electromotive force given by a battery simply by passing the current through the galvanometer of known resistance, measuring it, and then computing the electromotive force from Ohm's law. You would be unable to do this with your tangent galvanometer because its resistance is small compared with that of the battery, and therefore the latter would appear as an important factor in the result while its resistance is unknown to you.

VOLTMETERS.

The method universally adopted for getting around this difficulty and enabling the electromotive force to be measured directly is exceedingly simple. It consists merely in increasing the external resistance until it becomes so great that the internal resistance is so small a portion of the total resistance that it can be neglected without appreciable error.

A galvanometer wound with a resistance of several thousand ohms or connected in series with a like resistance will enable you to measure electromotive force directly without any sensible error. Such an instrument is called a *potential galvanometer*, or, if graduated, as it can be, so as to give the electromotive force in volts directly, it is known as a *voltmeter*.

Of course if a high resistance is in circuit the current is correspondingly small, and, therefore, there must be in the galvanometer a very large number of turns of wire to secure a readable deflection. It is usual, therefore, to have both a rather high resistance galvanometer and a considerable resistance in the circuit with it, the combination constituting the voltmeter. Practical voltmeters often have a total resistance of several thousand ohms, although much of it is frequently in an attached coil which has nothing to do with the galvanometer proper.

You will thus see that the galvanometer primarily enables you to measure current, but if it is of such high resistance that practically the entire fall of potential in the circuit is outside the source of electricity you are also enabled to obtain the voltage of that source. The measuring of voltage then by this method is thus only a direct application of Ohm's law.

MEASURING LARGE CURRENTS.

Another interesting application of Ohm's law is to the very accurate measurement of very large currents. You will see from this law that R in any conductor equals the fall of potential through it divided by the current. Now, if you have a very thick wire, or bar, of accurately known resistance and pass through it a current which you wish to measure, the fall in potential equals the current times the resistance. If you can measure this fall by means of a delicate high resistance galvanometer or voltmeter you can at once find the current. It is, of course, necessary in applying this method that the resistance should be known and remain constant, therefore the current should not be so heavy as to heat the resistance perceptibly, and thus alter its value. This method—known as the fixed resistance method of determining current—is exceedingly accurate and frequently used for testing ammeters and similar work.

MEASURING RESISTANCES.

A third application of Ohm's law of equal interest is to the determination of resistances, which, for any reason, it is inconvenient to measure by more common methods. For example, suppose you wish to know the resistance of an incandescent lamp: measure the current by passing it through an ammeter inserted anywhere in its circuit, then measure the fall in potential between the terminals of the lamp by means of the voltmeter. The resistance you can then find at once. It will be difficult to measure the resistance of an incandescent lamp when lighted by any other means, because the resistance of the carbon decreases very rapidly as it grows hot, and any measurements made except under the actual circumstances in which the lamp is used will not apply to its working condition.

(To be continued.)

Moonlight Tables for January, 1892.

Herewith we give Mr. H. W. Frund's table of lighting hours for the month of January, under his modified form of moon schedule:

TABLE No. 1.
Standard Moonlight. Philadelphia System.

Date.	Light.	Date.	Exting.
1	5:15 P. M.	2	6:25 A. M.
2	5:15	3	6:25
3	5:15	4	6:25
4	9:00	5	6:25
5	10:10	6	6:25
6	11:25	7	6:25
7			
8	12:35 A. M.	8	6:25
9	1:50	9	6:20
10	3:00	10	6:20
11	4:10	11	6:20
12	No light.	12	No light.
13	No light.	13	No light.
14	No light.	14	No light.
15	5:30 P. M.	15	7:30 P. M.
16	5:30	16	8:35
17	5:30	17	9:40
18	5:30	18	10:40
19	5:35	19	11:40
20	5:35	21	12:35 A. M.
21	5:35	22	1:35
22	5:35	23	2:35
23	5:35	24	3:40
24	5:40	25	4:45
25	5:40	26	5:50
26	5:40	27	6:10
27	5:40	28	6:10
28	5:45	29	6:10
29	5:45	30	6: 0
30	5:45	31	6:10
31	5:45	1	6:10

Total hours lighting, 232.30.

TABLE NO. 2.
Frund's New Moonlight System.

Date.	Light.	Date.	Exting.
1	5:15 P. M.	2	6:25 A. M
2	5:15	3	6:25
3	5:15	4	6:25
4	5:20	5	6:25
5	5:20	6	6:25
6	5:20	7	6:25
7	5:20	7	12:00 M.
8	12:35 A. M.	8	6:25 A. M.
8	5:20 P. M.	8	12:00 M.
9	5:25	9	12:00
10	5:25	10	12:00
11	5:25	11	12:00
12	5:25	12	12:00
13	5:25	13	12:00
14	5:30	14	12:00
15	5:30	15	12:00
16	5:30	16	12:00
17	5:30	17	12:00
18	5:30	18	12:00
19	5:35	19	12:00
20	5:35	21	12:35 A. M.
21	5:35	22	1:35
22	5:35	23	2:35
23	5:35	24	3:40
24	5:40	25	4:45
25	5:40	26	5:50
26	5:40	27	6:10
27	5:40	28	6:10
28	5:45	29	6:10
29		30	6:10
30		31	6:10
31		1	6:10

Total hours lighting, 301.45.

* Continued from THE ELECTRICAL WORLD, Jan. 9, 1892.

Some Curious Caprices of Lightning.

BY CARL HERING.

It may be said that electricians have obtained a very fair knowledge of the qualities and the actions of electric currents, such as used in commerce, but unfortunately the same cannot be said about the atmospheric electricity, appearing in the form of lightning. Although much has been written and much data have been collected, it cannot yet be claimed that we are able to control and become masters of these erratic currents. The only way in which we can hope to obtain control of them at some future time is to collect all possible data concerning the actions and the results of lightning in cases where it has manifested itself. The old adage of an "ill wind" applies in this case also, and we should make good use of the results furnished us in cases where lightning has struck and demolished buildings, with the hope that it may enable us in future to find out how to prevent such misfortunes.

In this connection some interesting data were given in a paper recently read in a German society of electricians by Dr. Neeson and discussed by others, in reference to some peculiar cases, of which the following is an abstract.

The storm was a very violent one, the skies were illuminated almost constantly for a half hour. The lightning struck a building 108 metres long and 15 metres wide, and completely unroofed the same. Fragments of the roof were scattered in all directions. Some of them were found 130 metres from the building. The adjoining illustration will show the location of the various buildings and the places where fragments were afterward found. The places where the lightning struck are indicated, as well as the location of the lightning rods. A very curious feature was that the building in the middle, *C*, which was higher than all the rest, was not struck at all. The noise of the thunder and the hail were so great that people in the neighborhood did not hear the noise caused by the destruction of the building.

On returning to the ground after the building had been struck a strong smell of sulphur (probably ozone) was noticed at the point *a*. The animals on these grounds and in these buildings were not injured. It will be noticed that there were numerous lightning rods located on these buildings, except on the one in the middle, which was not struck at all, and was higher than the rest. Each lightning rod had its special earth plate. The earth resistance varied from 10 to 20 ohms. The ground water was very deep, and the earth plates were lowered only one metre below the surface. There was no connection between the five plates, nor with any underground pipes. On some of the points the platinum tips were gone and on others they seemed to have been mashed down, but there were no signs on any of them of any fusion either of the platinum or of the copper. The roof of the building *A* was made of iron trusses.

In the roof above the point *a* there was found a round hole of about three-tenths of a square metre, but there were no signs of any kind to be found which would show that this hole was produced by a piece of the flying fragments; there were furthermore no signs of lightning having passed through the iron construction at this point. Among the débris found were a number of wooden joists which had been split in a straight line exactly in a plane in which a number of nails had been driven to fasten some cross pieces. On all of these fractures triangular black spots were noticed on both sides of each nail. In order to see whether this discoloring was due to moisture, other logs which had not been split were broken at similar points. A slight blackening was found in these also, but it was quite different from that in the others. In those split by hand the black coating could readily be rubbed off, while in the fractures presumably produced by the lighting the black coloring penetrated much deeper into the wood and was distinctly triangular in shape, the nail forming one side of the triangle. An analysis showed it to contain iron.

It was suggested that perhaps the destruction was due to wind alone, and not to lightning, but it was shown that the wind was by no means strong, not nearly as strong as the winds for which such roofs are constructed; furthermore, the location of the fragments would then have been in the direction of the wind, but this was not the case, as they were found scattered in all directions. It was also shown that it could not have been a wind of the nature of a cyclone, as that would have been noticed in the trees and neighboring fields. Furthermore parts of the roof were buried in the earth perpendicularly, which can be explained only by the fact that they must have tumbled vertically from a considerable height.

The sixty iron pillars which carried the roof extended one metre into the earth, and therefore formed a circuit of much lower resistance to the earth than the five earth plates of the lightning rod, and the roof formed a much larger condensing surface than the few lightning rods. An explanation is offered by one writer that the electricity passed up through these pillars into the roof, and thence into the wooden joists through the nails, where it developed steam from the moisture in the joists. This caused an explosion which split these joists. He states that it is well known that rotating air currents are produced in connection with a bolt of lightning, by which a rarefaction of the air* above the roof was produced, which raised the roof off the walls. He points out a great error in the construction of the lightning rods in that they were not connected together and were not connected with the metallic parts of the building.

In connection with this case the same writer quotes from a report of tests of lightning rods made in the Austrian army in connection with some magazines located on the high plateaus of some mountains. In these tests four experimental houses were built with different protections against lightning. The houses were 2½ by 5 metres, and were filled with cartridges, shells and other explosive material. One of them had a single rod at the top, which branched into four, leading down to the earth at the four corners and uniting under the earth. There was no earth plate. The second was completely covered with sheet iron connected to an earth plate; apart from the building was a lightning rod connected to this iron covering. House No. 3 likewise had a metallic covering, but it did not reach below the ground, otherwise it was like No. 2. On No. 4 there was no protection at all; beside it was a lightning rod on a separate post, whose earth connection passed through the building and near some of the explosive materials, where it was interrupted, and on the other side of this material it continued to the earth plate; that is to say, the explosive was placed in an interruption in the circuit. As there was no ground water to be reached, the earth plates, Nos. 2, 3 and 4, were made of carbon. In Nos. 2 and 3 there was, besides the explosives mentioned, a very sensitive mine exploder, one wire of which was connected to the top of the lightning rod and the other to the lower part of the metallic coating of the building.

All four of the buildings were struck by lightning. In Nos. 1, 2 and 4 the explosives remained uninjured, in No. 3 the mine exploder was ignited but nothing more. The result shows that a complete metallic coating, as also a well laid lightning rod, distributed along the corners of the building as described, was a perfectly sufficient protection. Also that the metallic covering which is not completed to the surface of the ground is not a complete protection, as the explosion of the mine cap showed. It was a pity that there was not also a mining cap placed in the first building.

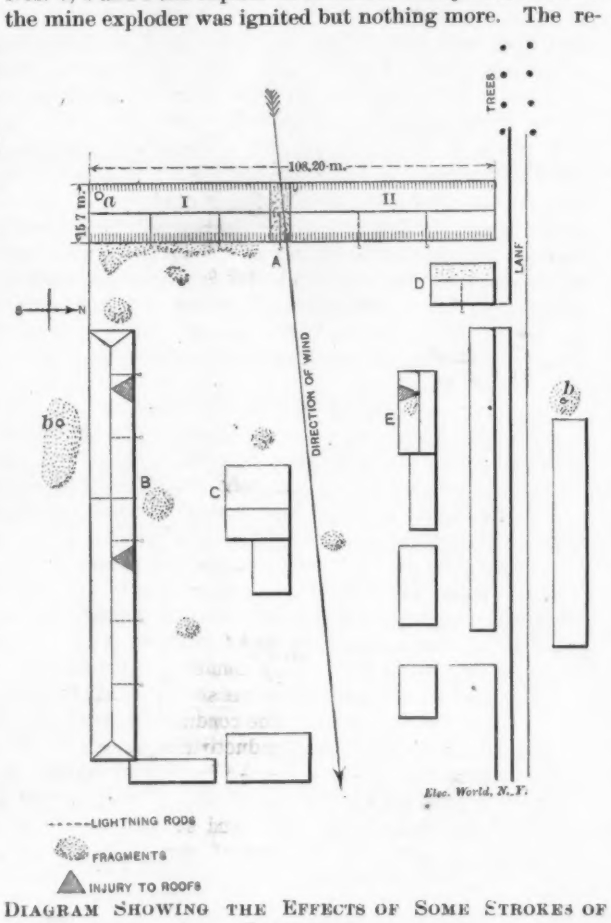


DIAGRAM SHOWING THE EFFECTS OF SOME STROKES OF LIGHTNING.

In addition to this, the following laboratory experiments were made: A small house, 600 square centimetres base, and 40 centimetres height, was completely enclosed with wire gauze, which we will call *H*. In this house was a large mass of metal, which we will call *M*, the weight of which was 30 kilogrammes, while the house weighed 20. On this mass of metal was a sensitive exploding cap. This mass of iron was either insulated or connected to the building. One of the wires of this cap was in most cases connected with *M* and the other either insulated or connected with *M* or *H*. A charge was then sent into *H* either from a Leyden jar or from the Holtz machine direct. In all cases except one the cap was not exploded when it was inside of the covering *H*. In the case in which it did explode one wire had been connected with *H* and the other with the metallic mass *M*, which was insulated from *H*. In another test in which *M* and *H* were connected together and to one of the wires of the cap, and the other insulated within two centimetres of the covering *H*, no explosion took place.

From these results it was shown that the metallic covering is not a complete safeguard for objects which are located between large masses of metal inside of the net when these large masses are insulated from the net itself. It was deduced from these experiments that a net completely surrounding the house is in all cases a sufficient protection even for parts of metal in the interior when this metal is completely insulated from the net, but that in cases when this is impossible, as for instance, in steam heating appliances, the lower end at least of the metallic covering should be insulated, and that persons or other conductors must not pass between the insulated end and the metallic covering. This latter conclusion, however, that the metallic masses should be connected only at one point with the externa covering does not appear to be substantiated, as in the building No. 3, above mentioned, the covering was not a complete one.

Mr. Buchholtz reports the following case: A large mass of cartridges was placed in a box covered on the inside with iron. This was placed in a field under a tree. The tree was struck by lightning, which entered the box, completely demolishing the lid, and throwing the cartridges about without exploding them. The box had no direct connection with the earth other than that produced by the condensed moisture on the bottom. In this case it is probable that the metallic covering formed a protection for the cartridges.

Other similar cases are cited, however, in which part of the cartridges exploded, and it is therefore to be concluded that whether they exploded or not is a question of accident. Another case was cited by Mr. Mueller, in which the powder magazine of the fortress at Koningstein was destroyed. The lightning rod had been proved a few days before and was found to be in good order. The lightning struck it, but only after a lapse of some time did the explosion occur which destroyed the building. It was therefore supposed that the lightning did not ignite the powder. As the explosives were on a wooden floor, he explains the fact by suggesting that as the wood was a bad conductor it was ignited by the lightning, and that this ignition caused the explosion. This was furthermore substantiated by the fact that several explosions followed the first. He suggests that it would probably not have occurred if the powder had been placed on metal plates instead of wood, the metal plates being well connected with the earth.

In this connection another curious case may be cited here by the present writer, for which however no explanation is offered. In a building in the city, which was one of a row of houses containing no lightning rods, there were a number of incandescent lamps connected to accumulators in the cellar. There was also a system of gas lighting wires, one pole of which was, as usual, grounded. There was no connection between the two systems and the accumulators were quite free from any connection with the ground, as they were placed on shelves suspended from the ceiling. One of the incandescent lights was burning at the time. There was also a loop connected to the arc light circuit of the street, but this loop was disconnected completely by a space of almost an inch at the switch, and being in the day time, there was no current on the line. There was a sudden and very violent bolt of lightning and at the same moment all the pendent burners in the house made a hissing noise which was so loud that it attracted the attention of persons standing some distance from them. The one incandescent lamp which was burning at the time suddenly became very bright for an instant only and then went out, and it was afterward found that the fuse for that circuit had blown. A complete search was made afterward, but no damage was found. One of the most curious features of the case was that an incandescent lamp connected with a 50-volt battery should have become brighter, because there was no means by which more than 50 volts could have been generated, except by the lightning. No signs could be found on the switch for the street line, although this would seem the only possible way of explaining the phenomenon, as it was quite possible that the lightning entered there from the street circuit and jumped from the lighting mains to the gas lighting wires, thence through the pendants to the ground. The writer was present, as it was in his own home, and can vouch for all the facts except the brightening of the lamp, which was seen by some one else. The fuse, however, was blown.

* Why could not this rarefaction of the air have been produced by the condensation of the moisture in the air, which by some is supposed to produce the thunder?

Welding by the Electric Arc.*

The Bernardos system of electric welding consists, as many of our readers are aware, in the use of an electric arc formed between the metal to be operated upon and a carbon manipulated by the workman. As originally used and described, the process did not appear to be very promising. It might be thought that an arc would be a difficult tool to handle, and the accounts of early experiments seemed to suggest that its usefulness would be confined to the repair of large pieces of work. The arc system of welding has, however, received the careful attention of Messrs. Lloyd & Lloyd, of Coombs Wood Works, Halesowen, near Birmingham. This firm is the largest manufacturer in Europe of butt-welded, galvanized, wrought iron gas, steam, water tubes and fittings. It may be mentioned that they stock about 200 miles of finished tubes, and the manufacture of ten miles a day is an ordinary rate.

The history of the application of the Bernardos process to this manufacture is interesting. Messrs. Lloyd & Lloyd were the first to introduce the system of gas welding for the manufacture of large iron tubes, the metal being heated locally by a powerful blow pipe. This mode of heating the metal allows a local application of the heat which is impossible upon a smith's hearth, and also permits much thinner and larger pieces to be handled. In fittings, that is to say bends, tees, elbows, etc., this is particularly noticeable. A diameter of six inches used to be the limit for wrought iron

* From *The Electrician*.

work, and even these could only be made by a few highly skilled workmen. Larger sizes could only be produced, at an almost prohibitive cost, from iron of ⅜ or ½ thickness. By the electric process, fittings of 12 inches diameter, $\frac{5}{16}$ thick, have been successfully made and tested to 800 pounds per square inch.

The process of arc welding resembles soldering in some respects, but it is essentially the same as that of "burning on," with two important differences, viz., that instead of relying on the heat contained in a quantity of molten metal, which is but a poor vehicle seeing its low specific heat, a continuous application of heat from a never-failing source is provided; and this heat is in the most efficient form, since it is at the highest temperature known to science. The simple "burning on' process is rarely used except for the repair of castings. The gas welding process made it possible to work thin metal, the patented process of gas welding of Messrs. Lloyd & Lloyd being used under license for the manufacture of corrugated flues. So similar is the electric arc process, that but for the intense light and fragrant smell of ozone it would be easy for any intelligent spectator to mistake the simple carbon holder for a blow pipe, and the roaring arc for a blow-pipe flame which appears to shoot out to the work.

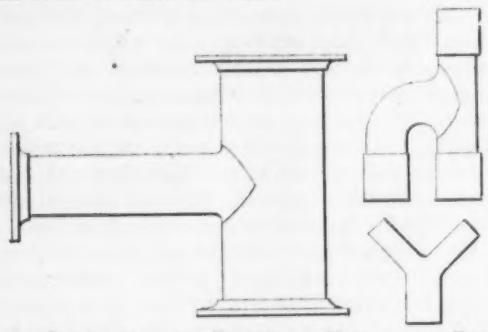


Fig. 1.—Samples of Fittings Made by Electric Welding.

A compound Davey-Paxman horizontal engine 12¾ inches and 20 inches × 24 inches, giving 100 indicated h. p. at 100 revolutions per minute, is employed to drive three Crompton dynamos of the ordinary pattern. These are respectively marked 140 volts 150 ampères, 150 volts 200 ampères, and 150 volts 200 ampères. They run continously during working hours, and, but for the higher voltage, differ in no way from Messrs. Crompton & Co.'s ordinary patterns. Carbon-tipped brushes (Fig. 2) are used, as in several central station dynamos of this make. The carbon prism is held by a stout copper plate, and effectually stops sparking with variable loads, while the bulk of the current is collected by the ordinary plate brushes just behind it.

The dynamos working in parallel are used to charge a large set of accumulators. There are 1,800 cells of the Planté type manufactured by Messrs. Lloyd & Lloyd, under the Bernardos patents. The plates, 9 inches × 7 inches, are constructed of zigzag strips of lead burned together by the arc process, and formed in a special manner. The appearance of the cells was very satisfactory; in the two years during which they have been at work, it has not been necessary to replace a single plate. The Planté type is suitable for this work, since very small storage capacity in ampère hours is needed, the function of the battery being simply that of a flywheel. It frequently gives a current twice that of the dynamos, and is capable of yielding a very heavy discharge, which, even though lasting for a very short time, would ruin a pasted plate.

In addition to the accumulators, regulating resistances are employed (Fig. 3), both in the instrument room and beside each bench, every workman having a switch close at hand to enable him to regulate the current to suit the job in hand. In the instrument room a number of voltmeters and ammeters show the performance of the dynamos and the current used in the shop. The usual current for each arc is about 150 ampères at 70 volts.

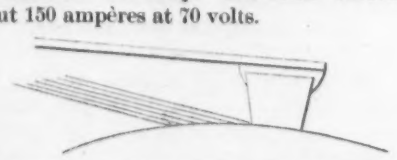


Fig. 2.—Brushes of Crompton Dynamo with Carbon Tip.

With the exception of the patent pipe-welding machine, to which we shall allude presently, the whole of the electric work was being done with the simple tool illustrated in Fig. 4. This consists of a wooden handle, through which a flexible cable is passed, a metal rod with a split clamp for holding a carbon, and an iron shield faced with asbestos to protect the hand. As a rule the carbon is the negative pole, while the positive lead is clamped to the table or to the work. This allows a longer arc to be formed, since it is a well known feature of the electric arc that the positive pole volatilizes, and in the present case the vapor of the metal greatly assists in maintaining the arc, which may be drawn out to a length of six inches, with a flame 1½ inches in diameter. An arc of from two to five inches is generally employed, the longer distance giving a more regular heating effect. The workman generally leaves the current on and places the tool on a support or on the bench. To start the arc he touches the metal, generally in a comparatively cool part near the portion being worked, and in a few seconds the metal is raised to working heat. Ordinary welds are made by placing a piece of iron or steel, weighing from one to two ounces, on the work; the arc is allowed to play until the metal begins to run, the degree of heat being carefully adjusted to the particular kind of job; the arc tool is removed and the portion is hammered in the usual way. Without the hammering, the joint, if made at all, would be very crystalline. It is possible that on the occasion of our visit the men were showing off their skill; but one group of three, engaged on a wedge weld of a large pipe fitting, while not working harder than ordinary piece workers, used the arc tool for 12 to 14 seconds, which sufficed to bring the bit of iron and the work on which it was laid to working heat; five to six seconds were spent in hammering, and the intervals during which the tools were changed seemed to occupy less than one second. Some 2 inches to 2½ inches of seam were welded at each heat, and thus about three heats were made in a minute, the work never being removed from the anvil. Hardly any slag or scale was to be seen. The fact that the work was made the positive pole probably created so copious a cloud of iron vapor that the oxygen of the air could not reach the heated surface. For some purposes, such as lead burning, the arrangement is reversed, and the carbon is made the positive pole. The metal in this case probably receives most of the heat by radiation from the carbon. While in the ordinary process of lead burning great cleanness of surface is essential, with arc welding the ordinary gray condition of the metal seems to offer but little obstacle.

To heat a considerable surface something more than a long and powerful arc is required. A very interesting pipe-welding machine has been built for making tubes of thin sheets, and in this a mechanical motion of the carbon produces the desired effect. The carbon holder is illustrated in Fig. 5. A vertical spindle arranged with a feather and depressing lever, exactly like that of a drill, carries a slide at its lower end, and to this, clamped by a bolt, is attached a carbon holder which can be set with any desired eccentricity. The spindle, which needs but little power to drive it, is mounted on a carriage, and a crank pin, capable of radial adjustment on a disc, moves the carriage to and fro by means of a connecting rod. Tubes of about nine inches diameter and two feet length were being made up from thin sheet. The carbon described a circle of about two and one-half inches diameter, making 200 to 400 revolutions a minute, while the carriage had a traverse of about four inches, making about 30 strokes a minute. The motion was given by a small motor mounted on the machine, and was controlled by a

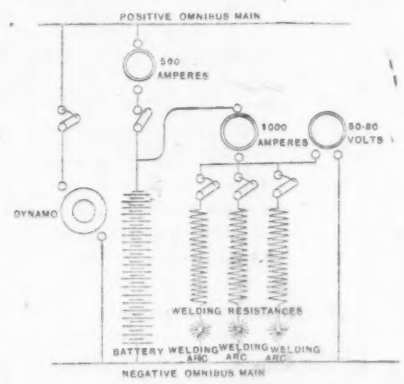


Fig. 3.—Diagram of Connections of Dynamos, Accumulators, Instruments, Resistances and Arcs.

switch. The tube was placed on a mandrel, having a fire-brick lump below the arc. The tube being slipped on, the carbon holder was brought down to start the arc, and was then raised about three inches and set spinning. The end of the arc was at first confined to one spot on the work, but the metal becoming hot it soon spread out, and after a few seconds described a larger circle than the carbon itself The rotary motion of the carbon, combined with the traverse, covered some 15 square inches. The current used was from 250 to 300 ampères. An Aron meter registered the whole quantity. Pieces of steel were laid on the seam; and when working heat was reached, the arc and the motor associated with it were shut off, the tube shifted longitudinally a foot or so on to the mandrel, and a Player hammer rapidly worked up the weld. The hammer was run by another electric motor mounted on the top of the machine, and was controlled by a third switch. These switches were mounted on a sloping metal screen, which protected the smith from the intense heat, but allowed a good view of the work through a red glass pane. The other men were provided with similar glass screens, either fixed to the machine or held in the hand; or wore suitable spectacles. Wooden partitions or boxes are arranged round each bench, and a large red glass window is provided in each. A passer-by is thus protected from an accidental glimpse of the powerful arcs. The same men are now engaged in welding who were at work on the process when first started. They are allowed to work in their own way, and are not subjected to constant instructions, as so often happens when a new process is introduced. No difficulty has been found in getting men who are willing to learn to handle the carbon, and we understand that no welder has ever left the work, or suffered in health or sight.

Hydraulic fittings with complicated branches set at acute angles can be easily made, the seam being welded bit by bit. The sheets from which large and thin elbows and tees are made are cut out into gussets by the use of an arc. The metal drops away like wax, leaving a somewhat ragged cut of about ¼ inch. While incomparably superior to chisel and hammer work, and dispensing with heavy punches and shears, the chief advantages in the use of an arc for cutting appear to be that the smith who is to complete the work can cut it out as he pleases, instead of having to use sheets cut out, perhaps by another man in another department; and in the facility with which cutting can be done on work *in situ*, where it is not convenient or possible to bring it into the shops.

Associated with the principle of cutting is the important application of the arc to repairing work, an application which, as we have mentioned, received early attention from M. Bernardos. Steel and iron castings, facing points, locomotive wheels, pump-rods, and many other objects have been well repaired by this process. The arc is directed on the flaw or crack; the metal runs away; the arc and the piece to be repaired are so handled that a suitable cavity is formed. Sound metal is then filled in by melting down small pieces, which, if necessary, are actually welded into place, a treatment which is, of course, impossible in the otherwise analogous process of "burning on." For steel castings particularly, this process seems to be of great value, since serious flaws are often discovered only after a considerable amount of tooling has been done.

Another distinct branch of the work is the flanging of tubes. Any thickness of flange can be welded to any thinness of pipe, or the pipe itself can be flanged out. The work is mounted in a lathe, and the arc is directed on to it while it revolves, and when sufficiently hot a presser

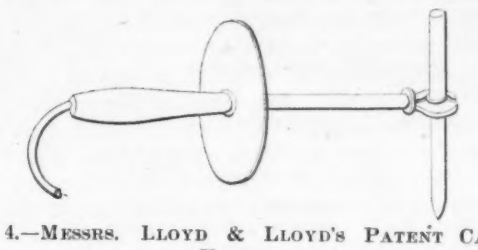


Fig. 4.—Messrs. Lloyd & Lloyd's Patent Carbon Holder.

mounted on a hinged arm completes the weld as it revolves. The job appears to be more easy than the spinning of dishes by a tinsmith.

After a thorough experience of gas welding, Messrs. Lloyd & Lloyd have no hesitation in saying that with two years' experience as sole licensees of electric welding on the Bernardos system, the arc work can be done at one-fourth of the expense of the blowpipe. This result is largely due to the improved appliances which have been invented by Mr. Henry Howard, of Stonehouse, Kidderminster, the acting partner of the firm at Coombs Wood. Of the quality, it is only sufficient to say that a large quantity of hydraulic fittings are made; and though they do not generally run to more than two inches diameter, they are in all cases tested to high pressures from 1,000 lbs. to 3,000 lbs. per square inch. Messrs. Kirkaldy's tests of bar welds are highly satisfactory, and the range of possible applications of the process seems to be very wide.

If only because the bulk of the work done by arc welding, and certainly all those examples which we have mentioned, would not be suitable for the butt welding of the Thomson process, a comparison would be unnecessary. The latter possesses undoubted advantages for welding wire, rods and bars. It has induced some manufacturers to change their designs in order that its full advantages might be gained. What it could not do can be done by arc welding, and there are but few jobs which can be done by neither. A most important consideration is the small cost of plant for the arc system. The dynamos are not expected to give the full working current, and their load factor is high. The batteries are not expected to have any con-

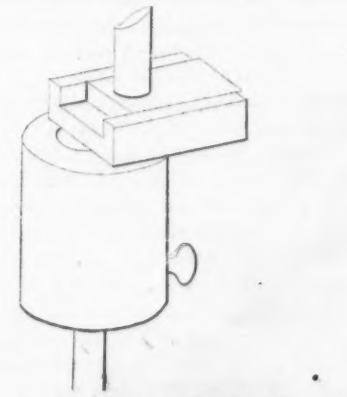


Fig. 5.—Messrs. Lloyd & Lloyd's Patent Mechanical Arc Heater.

siderable storage capacity. The leads are moderate in size. The volts are practically constant, and lights may be run off the same circuit. The ordinary mode of applying the heat is the simple handling of a tool worth a shilling or two. To educate men to use a blowpipe was not difficult, and the change from the blowpipe to the arc is hardly any change at all.

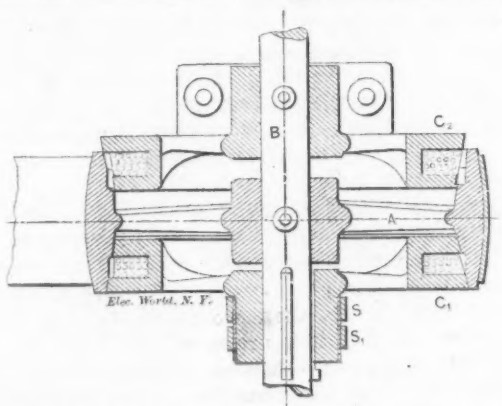
A large party of engineers and representatives of the press recently left the fogs of London by a special train, and after having luncheon at Birmingham, where the sun was shining brightly, visited the Coombs Wood Tube Works. In the handsome mess-room was a display of samples of work done, including very large bends and other fittings, flangings, repaired forgings and castings, and Kirkaldy test pieces. The works were then visited,

and the processes of electric welding and other work were watched with great interest, a large pile of dark red glass screens having been provided for the visitors; more than one of whom, however, suffered afterward from accidental glances at the arcs or careless use of the screens. The extensive gas tube department, stores and fitting making shops were inspected, and all questions were answered and information was freely given to inquirers by the members and the staff of the firm.

Electro-Magnetic Safety Coupling.

During the past few years persistent efforts have been made, says *Engineering*, to facilitate the working of heavy clutches and couplings, and with very considerable success. There are now in the market several friction clutches which can be manipulated with comparative ease. To render the matter still easier—so easy that a large coupling can be engaged and disengaged by the pressure of a finger—there is being introduced by Messrs. Siemens Brothers & Co., Ltd., of 12 Queen Anne's Gate, Westminster, an electro-magnetic coupling which gives perfect control of any piece of machinery to which it may be applied, enabling it to be stopped and started with great rapidity and without any exertion on the part of the attendant. A weak electric current, about half of that required to run a 16-candle power incandescent lamp, supplies all the power required to keep the two parts of the coupling together when they are engaged, and to bring one part to immediate rest when they are to be disengaged. This current can be obtained from electric lighting mains, or when there are several such couplings in a works a small dynamo can be put down for the purpose.

The annexed engraving shows in section a pulley fitted with an electric magnetic coupling. The pulley runs loose on the shaft between two annular electro-magnets, and forms an armature for both. One of these, C_1, is keyed to the driving shaft, the other, C_2, is stationary, being fixed to the framework supporting the shaft. The current passes to the revolving magnet, C_1, through two metal rings, S,



SIEMENS' ELECTRO-MAGNETIC COUPLING.

S_1, insulated from each other. When the magnet, C_1, is excited, it attracts the armature A. By so doing it couples the pulley A to the driving shaft B, and puts it in motion. On the other hand, if the magnet C_2 be excited, it attracts the pulley A and throws it out of gear. At the same time the attraction brings it into contact with the stationary magnet, which acts as a brake and stops it. To facilitate this operation, the electrical connections are so arranged that the current, when switched from one magnet to the other, is reversed for a short time in the coil of the former magnet. This prevents the armature sticking to the magnet by reason of residual magnetism.

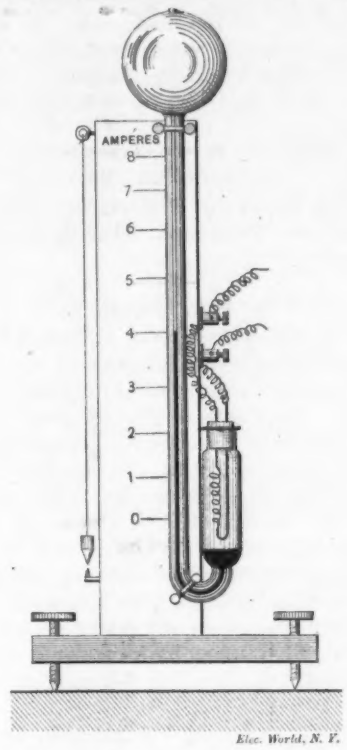
It is often convenient to be able to control a coupling of this kind from several points, so that, in case of accident, the machine or shafting that it drives may be immediately stopped. To this end, therefore, the switch is operated by a weighted lever which can be released by a trip device operated by an electro-magnet. Included within the circuit of the electro-magnet are a number of contacts by any of which the circuit can be broken. As soon as this is done the magnet ceases to be excited, the trip device is operated, the weighted lever falls, and the switch diverts the current from the coupling to the brake. To re-engage the clutch the switch is reset by hand.

Many uses for such clutches will suggest themselves, such as for replacing fast-and-loose pulleys, operating cones on overhead traveling cranes, replacing claw clutches on spinning mules, and the like.

A Crude Amperemeter for Continuous and Alternating Currents.

In practice there is often a need of a simple and cheap ampèremeter which will give sufficiently good results for practical purposes and which is not too sensitive to sudden and periodic variations to make it oscillate so as to interfere with the reading. In this connection the ampèremeter described by Mr. Debrun in a recent number of *L'Electricien* may be of interest.

As will be seen from the adjoining figure it consists of a sort of thermometer based on the expansion of air heated by the current. The construction of it is readily seen from the figure. The small coil in the lower arm of the tube is made of some resistance wire, which must be properly proportioned so as to give any desired range of readings. The liquid in the U-tube is made of a mixture of water and glycerine colored with fuschine. In order to avoid sealing the wires in the glass tube a cork is used and is boiled in Canada balsam and sealed with some convenient sealing material. The graduations are made by comparison with any ordinary ampèremeter for continuous current. As the instrument is based on the heating qualities of the wire, it may evidently be used for alternating



AN AMPEREMETER FOR CONTINUOUS AND ALTERNATING CURRENTS.

as well as continuous currents, for both of which the scale will be absolutely the same. As both bulbs are sealed, the apparatus is independent of the external pressure as well as of the temperature. As it depends for its action on the dissipation of the heat from the outside of the lower tube, it must not be placed in a draught. It is said to respond quite quickly on the application of the current. It can be used as a voltmeter if the coil is properly proportioned, and in this form it may be used to a certain extent to replace the Cardew voltmeter for alternating currents. It is evidently not an instrument of precision, but, being simple in its construction and adaptable to very great ranges of readings, it will, no doubt, be found to be quite a useful instrument in practice.

The Probable Future of Condensers in Electric Lighting.

BY JAMES SWINBURNE.

II.

The next use for condensers, which is analogous to those already described, is in connection with motors. Of course it is a little difficult to say what the alternate current motor of the future will be like. If it is a synchronizing machine, with the magnets excited by a direct current, it may take a leading or lagging current, or one in step with the pressure. If it has field magnets excited by an alternate current it will take a lagging current, and condensers will be necessary. Nearly all the multiple current motors take large exciting currents, so condensers will be necessary in

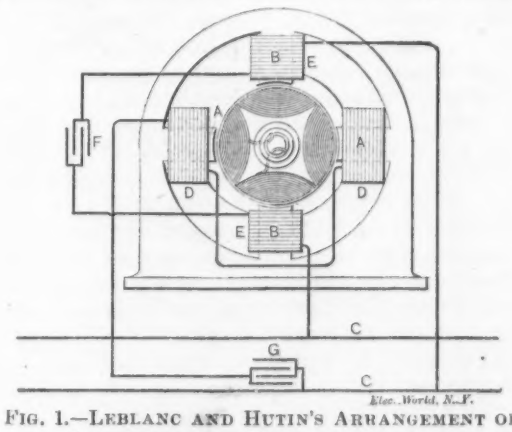


FIG. 1.—LEBLANC AND HUTIN'S ARRANGEMENT OF CONDENSERS FOR LIGHTING CIRCUITS.

their case. Take the case, for instance, of the Dobrowolsky 2 h. p. motor, as it is the only case whose figures have been published: at no load it takes 70 volts and 30 ampères at 35 periods per second. This current is presumably in both circuits, so that the apparent power is 4,200 watts. At full load it takes 70 volts and 100 ampères in each circuit, or 14,000 apparent watts. It, therefore, requires two condensers to reduce the apparent watts to about a tenth of these values. The enormous exciting current taken by this form of motor is one of its greatest disadvantages. A condenser to supply 14,000 apparent watts at a frequency of 35 would have a volume of four cubic feet. If the frequency is raised to 100 the exciting current increases at approximately the same rate, and so that condenser remains the same size. As there is some difficulty in making large low pressure condensers, it is best from that point of view to put the condenser on the high pressure side of the transformer. This, unfortunately, demands that the transformer should be 10 times the size. Thus, a 2-h. p. motor of this type would demand a 20-h. p. transformer at a frequency of 35, or a 60-h. p. and 100 periods per second. The transformers are nearly the same size in these two cases. The enormous size of the transformer is a great drawback to machines excited by alternate currents, and, unless multiple current motors can be greatly improved, this fault alone will be enough to render them useless for most work.

So far the condenser has been described as arranged in shunt to the current containing self-induction. It has then no effect on the circuit with self-induction, but affects the dynamo. In fact, it supplies exciting current instead of letting the dynamo supply it. The self-induction can, however, be counteracted by arranging capacity in series with it. For instance, suppose the alternate machine is made like one for direct currents, except that the field magnets are laminated. Suppose the machine in question is a 10-h. p. motor for 100 volts. If the field magnets are wound to suit 100 volts on a direct current circuit, they will be only very slightly excited by the alternating pressure. If the number of turns is much reduced and the diameter increased, full excitation will eventually be reached, but the current will be enormous. For instance, if the magnets take two ampères on a 100-volt direct current circuit, the loss in copper is 200 watts, but to drive two ampères through the inductive circuit with an alternate current would probably need something like 5,000 volts. If a few turns of large wire are used instead, the full excitation will probably be reached with about 100 ampères. Not only is the exciting current enormous, but the armature current is not in step with the field induction, therefore the output is also lessened from this cause. M. Leblanc was the first to point out a method of overcoming these troubles by the use of condensers. A condenser may be put in series of such a capacity that at the frequency employed the electromotive force of the condenser is always exactly

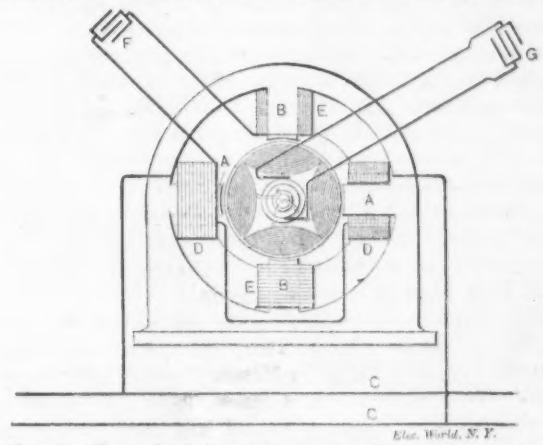


FIG. 2.—TESLA'S ARRANGEMENT OF CONDENSERS FOR LIGHTING CIRCUITS.

equal and opposite to that of the self-induction of the magnets. This condition can only be obtained approximately, since the pressure does not vary perfectly harmonically. If it did, all the electromotive force of the supply circuit would be spent on resistance, so that the same current would be produced as if the magnets were excited by a direct pressure. The field induction is then in step with the electromotive force, so that the armature current is so also, and the power taken by the motor is found by multiplying the pressure by the current.

Messrs. Stanley & Kelly have designed and worked out a motor on this principle. It is constructed like an ordinary direct current shunt motor, but has laminated field magnets. A condenser is arranged in series with the magnets. This motor has some drawbacks. In the first place, if the field magnets and armature are on a 100-volt circuit, the pressure on the condenser and on the field coils will be something like 5,000 volts, and this might make the motor too dangerous for admission to private premises. Of course this depends on the size and design of the motor. It may be possible to design a machine with much lower condenser pressure. The loss by hysteresis in the field magnets is also necessarily large; but that is not such a serious matter in a motor as in a transformer, which is in use day and night. The next trouble is sparking at the brushes. The armature coils are short circuited just at the time of the most rapid change of field, so that there is a large current in the short-circuited section. I would suggest that this trouble can be overcome by winding the armature with two separate circuits in parallel. The brushes then collect from both but never short circuit any of the sections.

The Tesla motor, as is well known, demands two or more currents differing in phase. Two currents differing a quarter of a period will suffice. At first special dynamos with double armature circuits were used as generators, but several arrangements involving condensers have been proposed. The first experiments of this kind were probably made by Prof. Ayrton and Dr. Sumpner. They had a small Tesla motor some years ago, but made up some arrangement with self-induction and capacity so as to split a single current into a double one. The experiments have not been published, therefore I do not know what the exact arrangement was. Mr. Tesla has designed numerous arrangements himself, but the most complete investigations have been made by Messrs. Leblanc and Hutin, and those interested

in this subject will do well to read the able articles in the *Lumière Electrique*, which have been appearing recently at short intervals. These authors have gone most carefully and exhaustively into the whole subject of alternate current motors of all sorts, and their papers are very suggestive. Fig. 1 shows a very simple arrangement due to them. One field magnet circuit, *E E*, has a condenser in series with it. Its current and induction are therefore in step with the pressure, and the wire used is the same as for direct currents under the same pressure. The other magnets, *A A*, however, are wound with few turns of low resistance wire, *B B*, and take a large current, which lags practically a quarter of a period behind the pressure. In all practical cases the lag can be adjusted to a quarter of a period by using a condenser of the right capacity in the first circuit.

It is to be feared that there will be great difficulty in working out this system to be right at various loads. As the load increases an active current should flow in both circuits. The circuit with the condenser in series with it cannot take its load current, so that the full load output of this form of motor may be little more than half that of a double current motor of the same size. It is probable, however, that the ingenuity of Messrs. Hutin and Leblanc, in France, or Mr. Tesla, in America, may overcome this drawback. A multiple current motor is, however, thus obtained, which will work on ordinary supply circuits. Only one of the sets of magnets takes a large "idle" current; but to avoid troubles from this the use of a second condenser, *G*, in shunt to the main, *C C*, or to the transformer that supplies the motor is advisable. This condenser is of the same cubical contents as the first, but unless arranged on the high pressure side of the transformer it is designed for a much lower pressure and for a correspondingly larger current. By this means a self-starting motor can be obtained which has no brushes, which works on an ordinary supply circuit, and which gives full torque on starting. It has, however, the same drawbacks as the type first described. The dangerous pressure on the field coils of the first circuit may be reduced by arranging the magnet coils in small portions alternately. If the fields take, say, 12 coils, the coils and portions of the condenser may be arranged alternately, so that the maximum pressure is just over 400 volts, due to the condensers. The fall over the resistance of the circuit is out of step with this, and may therefore be neglected. Mr. Tesla has also patented an arrangement on the same principle as Messrs. Hutin and Leblanc. He uses one field circuit partly as a transformer to transform up, and then places the condenser *F* in the secondary circuit *D E D E*. This seems rather to increase the difficulty arising from the very high pressures resulting from arranging condensers and induction coils in series. His arrangement is shown in Fig. 2. He has also put a condenser in the armature circuit, but it is difficult to see the inventor's object in this. Whether this form is the motor of the future or not is difficult to say; but if it is, the number of condensers required will be considerable, so we are justified in discussing it at some length in this article.

There is still another possible use for condensers, and that is for exciting dynamos. An alternate machine may be regarded as made up of two elements. One has constant induction, and is called the field magnet; the other is variable, and is called the armature. The field magnet may be excited by a direct current round it, or by an alternate current in the armature which is direct relatively to the field, because the armature changes position while the current changes its direction. As far as copper in the machine goes, it is cheaper to excite the fields by arranging the machine so as to have considerable armature reaction, and exciting by means of a condenser. Suppose when the field has its own coils the current density and weight of copper are the same in the field magnet and armature; if the field coils are removed and the condenser applied, the armature copper need not be doubled; it will carry the current at the same density as before, if the copper is increased in the proportion 2 : 1. The total power wasted is then less than before; in fact, if the armature copper is not increased at all, the loss of power in the armature alone when the condenser is used is the same as that in the armature and field magnets together, with separate excitation. By the use of a condenser, cheapness, or high efficiency, or a compromise of these can be obtained. The condenser itself is generally much cheaper than an exciter, and is, of course, very much more efficient. An alternate machine with a condenser follows practically the same laws as a shunt-wound dynamo, but it has only one copper circuit, and no commutator.

Perhaps enough has been said to show that condensers may have a large future. New possibilities are appearing every day, and there is no saying what combinations of capacity, self-induction and resistance may be invented during the next few years.

A New Form of Electric Measuring Instrument.

The illustration on this page shows an electrostatic instrument recently brought out by Messrs. Swinburne & Co. for experimental work in connection with alternate currents. Instead of quadrants there are two pairs of half discs, so that the angle of deflection can be large. The needle consists of two half discs fastened on a metallic arbor. It is held by top and bottom suspensions. One disc is in the upper box and the other in the lower. The boxes are connected, not to ordinary terminals, but to highly insulated flexibles, as the ordinary terminals are not suitable for high pressures. This instrument can be used as a voltmeter, or it may be connected up to measure power by any of the various methods involving two readings. It can also be connected up as a direct reading wattmeter. The electro-magnet below the boxes acts on a copper drum, and renders the instrument dead beat. This magnet is excited by a cell. For large readings the torsion head and pointer on the top of the instrument are used; but for small readings the mirror is employed. Four of these instruments have been lent to Dr. Fleming to carry out experiments on the measurement of power by various different methods.

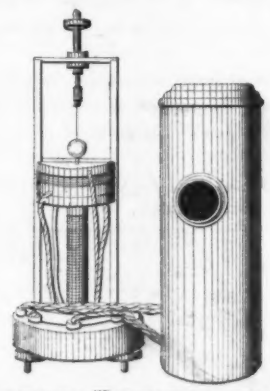
(*Copyrighted, 1890.*)

Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.*

BY P. F. MOTTELAY.

A. D. 1793.—Aldini (Giovanni), nephew of Luigi Galvani and one of the most active members of the National Institute of Italy, who succeeded his former instructor, M. Canterzani, in the Chair of Physics at the Bologna University, established in the last named institution a scientific society whose object was to combat all of Volta's works and which was naturally very hostile to the organization already formed in the University of Pavia by Felice Fontana, Bassiano Carminati and Gioachino Carradori against the followers of Galvani. Similar societies espousing the cause of Volta were afterward organized in England, at the suggestion of Cavallo, and, for five years, the scientists of Europe were divided between the two discoverers, without, however, any material benefit accruing therefrom to either faction.

Aldini proved to be an indefatigable investigator, as shown by the numerous Memoirs sent by him to the publications named below, up to the month of October, 1802, when he experimented before the Galvani Society of Paris. An account of these experiments is given in his "Essai théorique, etc.," where, among other results, attention is called to the curious fact that contractions can be excited in a prepared frog by holding it in the hand and plunging its nerves into the interior of a wound made in the muscle of a living animal. (Figuier, "Exposition, etc.," vol. IV., page 308.) His interesting investigations of the artificial piles of muscle and brain, first made by Mr. La Grave and shown to the French Galvanic Society, are alluded to in *Nicholson's Journal*, vol. X., page 30, in the *Journal de Physique*, An. XI., pages 140, 159, 233, 472, and in Sturgeon's "Scientific Researches," Bury, 1850, page 195.



An Electrostatic Voltmeter and Wattmeter.

Nearly all of Aldini's experiments were successfully repeated in London at Mr. Wilson's Anatomical Theatre, where Mr. Cuthbertson assisted Prof. Aldini in arranging the apparatus, and where a student, by the name of Hutchins, furnished the anatomical preparations, but that of all others which attracted the most attention was doubtless the one made in London on the 17th of January, 1803. The murderer Foster had just been executed and, after his body lay for one hour exposed in the cold at Newgate, it was handed over to Mr. Koate, President of the London College of Surgeons, who, with Aldini, made upon it numerous important observations to ascertain the precise effects of galvanism with a voltaic column of one hundred and twenty copper and zinc couples. The extraordinary results obtained, which cannot properly be enumerated here, are to be found in the "Essai Théorique, etc.," already alluded to. They led Aldini to believe he could, by the galvanic agency, bring back those in whom life was not totally extinct, such as in cases of the recently drowned or asphyxiated. (See M. Bonnejoy's method of proving death by . . . Faradization, Paris, 1866, and Georgio Anselmo, "Effets du Galvanisme . . . ," Turin, 1803; S. T. Sommering, "On the application of Galvanism to ascertain the reality of death," Ludwig scripter nevrolog., III., 23; Ure, "Exper. on the body of a criminal . . ," Journal of Sc. and Arts," No. XII.; *Phil. Mag.*, vol. LIII., page 56; Jean Janin de Combe Blanche, "Sur les causes, etc.," Paris, 1773 (hanging); C. W. Hufeland, 1783, for the app. of Elec. in cases of asphyxia; T. Kerner, for the appl. of Galv. and Magn. as restoratives, Cannstadt, 1858; Wm. Henley, for electricity as a stimulant . . . drowned or . . . suffocated, "Trans. of the Humane Society," vol. I., page 63).

Another of Aldini's curious experiments was the production of every powerful muscular contraction upon the heads of oxen and other animals recently decapitated, by introducing into one of the ears a wire connecting with one of the battery poles and into the nostrils or tongue a wire communicating with the other pole. Thus were the eyes made repeatedly to open and roll in their orbits, while the ears would shake, the tongue move and the nostrils dilate very perceptibly. (De la Rive, "Electricity," 1856, vol. II., p. 489; Pepper, "Voltaic Electricity," 1869, pp. 287, 288). In the experiments which Aldini made during 1804 upon corpses, the body would become violently agitated and raise itself as if about to walk, the arms would alternately rise and fall and the fore arm could be made to hold a weight of several pounds, while the fists would clench and beat violently the table upon which the body lay. Natural respiration was also artificially re-established and, through pressure exerted against the ribs, a lighted candle placed before the mouth was several times extinguished.

For the experiments of the eminent French physiologist and anatomist Marie François Xavier Bichat, of Vassalli-Eandi, Giulio, Rossi, Nysten, Halle, Mezzini, Klein, Bonnet, Pajot-Laforest, Dudoyon, Berlinghieri, Fontana, Petit-Radel, Alizeau, Lamartillière, Guillotin, Nauche and others upon animals and men recently decapitated, see Bichat's "Recherches Physiologiques sur la vie et la mort," Paris, 1805; Francesco Rossi's "Rapport des expériences, etc.," Turin, 1803; P. H. Nysten's "Nouvelles Expériences Galvaniques, etc.," Paris, 1811, and also the latter's "Expériences faites . . . le 14 Brumaire, An. XI." (See, likewise, J. R. P. Bardenot, "Les Recherches . . . refutées," Paris, 1824, and, for an account of Bichat consult F. R. Buisson, "Précis historique . . . ", Paris, 1802; Larousse, vol. II., 703, 704; "Biog. Univ.," vol. XI., pp. 2–19).

In Aldini's "Account of Galvanism," printed for Cuthell and Martin, London, 1803, it is said (page 218) that, on the 27th of February, 1803, he transmitted a current from a battery of eighty silver and zinc plates from the West Mole of Calais harbor to Fort Rouge, through a wire supported on the masts of boats, and made it return through two hundred feet of intervening water.

See J. B. Van Mon's treatise on animal electricity in tome III. of the sixth year of the "Magasin Encyclopédique;" Fowler, in "Bibl. Brittanica," May, 1796; Giulio e Rossi ("Gior. Fis. Med. di Brugnatelli," 1793, vol. I., page 82); P. Sue ainé, "Hist. du Galvanisme," Paris, An. X., 1802, vol. I., pages 31, 67, 73; vol. II., page 268; Brugnatelli, *Annali di Chimicia*, vols. XIII., page 135, XIV., page 174, XIX. pages 29, 158; "Opuscoli Scelti," vols. XVII., page 231, XIX. page 217, XX., page 73, XXI., page 412; "Mem. Soc. Ital." vol. XIV., page 239; Poggendorff, vol. I., page 27; "Galvanische und elektrische. . . ," Korpern, 9to, Frankfort, 1804; "Bull. des Sc. de la Soc. Philom.," No. 68; J. C. Carpue, "Bibl. Britannica," Nos. 207, 208, page 373; *Phil. Mag.*, vols. XIV., pages 88, 191, 364, XV., page 93; Cassius Larcher, M. Daubencourt et M. Zanetti ainé (*Ann. de Chimie*, vol. XLV., page 195), also Larcher, Daubencourt et M. de Saintiot (Précis succinct, etc.," Paris, 1803); W. Sturgeon "Scientific Researches," Bury, 1850, page 194: Mr. Kilian, "Versuche uber restitution . . .," Giessen, 1857; Gilbert, IV., 246; J. Tourdes ("Décade Philos." No. 3, An. X., p. 118); Francesco Rossi ("Bibl. Ital.," vol. I., p. 106; *Phil. Mag.*, vol. 18, p. 131; and in the "Mémoires de Turin"); J. J. Sue, "Recherches Physiol., etc.," 1803, p. 77; Vassalli-Eandi ("Expériences sur les décapités . . .," Turin, 1802 and "Recueil . . . de Sédillot," vol. II., p. 266; C. H. Wilkinson, "Elements of Galvanism, etc.," London, 1804, 2 vols., *passim;* Report of MM. Chappe, Robillard and Sylvestre ("Bull, des Sciences de la Soc. Philom.," No. 21, for March, 1793, also *Jour. de Phys.*, vol. 42, p. 289); M. Payssé ("Jour. de la Soc. de Pharm.," first year, p. 100); Dr. Crickton ("Rec. Period. de Litt. Méd. Etrangère," tome 2, p. 342); J. Louis Gauthier, "Dissertatio, etc.," Hales, 1793 ("Com. de Leipsic," tome 36, p. 473); Gardiner's "Observ. on the animal economy;" Humboldt ("Soc. Philom.," vol. I., p. 92); Alex. Monro's "Experiments, etc.," Edinb., 1793, 1794 ("Trans. Edinb. Roy. Soc.," vol. III.)

A. D. 1793.— Fowler (Richard), a very ingenious physician, of Salisbury, makes known in Edinburgh his "Experiments and Observations relative to the influence lately discovered by Galvani and commonly called Animal Electricity," of which a very complete review is made by Dr. G. Gregory at pages 374–381, vol. I., of his "Economy of Nature, etc.," third edition, published in London during the year 1804.

Dr. Fowler observed that the contractions in a frog are excited by making the metals touch under water even at the distance of an inch from the divided spine of the animal. He succeeded in exciting the heart to contract, but could not produce the same effect upon the stomach and intestines. He also found, as did Professor Robinson, of Edinburgh, at the same period, that the senses of touch and smell are not affected by the metals, but that when these are applied to the eye, or, what is better, when they are thrust up between the teeth and the lips, and then made to touch, a flash of light is rendered visible. This is the case also when the metals are placed between the gums and the upper and lower lips, as proven by the experiments of Dr. Rutherford and of Mr. George Hunter, of York. Fowler likewise observed that all metals, when pure, are excellent conductors of the galvanic influence and that living vegetables afford it a ready passage, but that stones and oils seem to be possessed of no conducting power whatsoever.

* Continued from The Electrical World of Jan. 9, 1892.

Secondary Batteries.—II.*

BY G. H. ROBERTSON.

II.—IMPROVEMENTS IN THE FAURE TYPE.

This class is that in which the peroxide of lead and spongy lead are formed by electrolysis from some oxide applied to the plates.

As in this class of cell the active material is applied to the electrodes, and not formed from them as in the original Planté cell, it is obviously desirable that the supporting

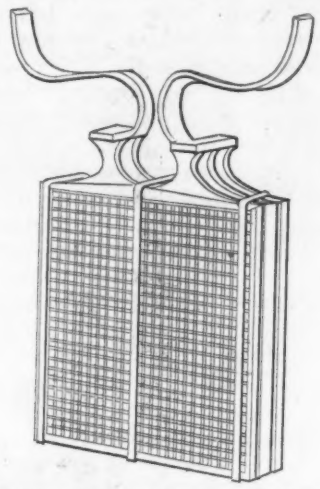


FIG. 2.—ELEMENT CONSOLIDATED ELECTRIC STORAGE COMPANY.

part of the electrode should be light, and not weakened by taking part in the chemical reactions. These requirements have been met in many instances by replacing the solid lead plate by a grid, usually made of an alloy of lead and antimony, since such an alloy is less acted on by the acid, and is much stronger than pure lead. In the E. P. S. cell the use of an alloy of lead and antimony was abandoned, because, if sufficient antimony to obtain a good casting was added, the grid was so hard that it did not yield to the expansion of the paste, which consequently forced itself out of the plate. Lead grids were then employed, but now

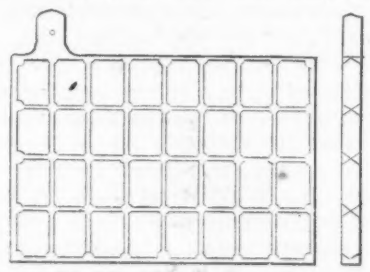


FIG. 3.—PLAN AND SECTION GADOT PLATE.

they have been abandoned for rapid discharge work and a solid plate has been reverted to.

In the latest form of Mr. FitzGerald's lithanode cell, weight is reduced by making the support of a light double frame of copper wire, protected from the action of the acid by dipping it first in soldering fluid and then in molten lead.

The other improvements fall into two principal divisions: (*a*) Those which have for their object the retention of the paste on the plate, and they may be classed under four headings; (*b*) those intended to provide better connection between the support and the active material.

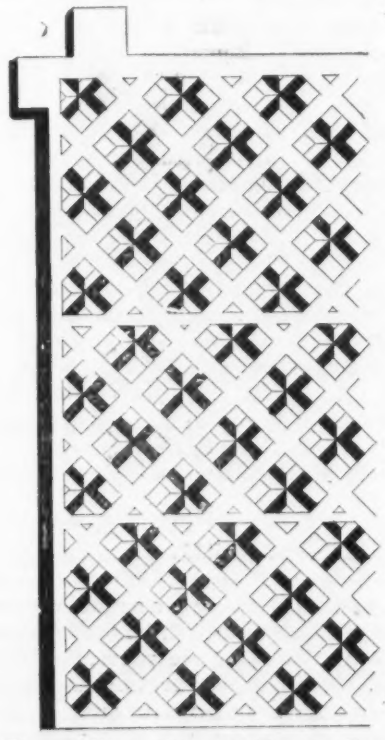


FIG. 4.—PLAN CORRENS DOUBLE GRID.

a. The Retention of the Paste.—1. The plate is not perforated, but grooves or recesses are made on the surface; or it is cast with projections from it, so as to afford a lodgment for the active material.

The Tudor plate is a familiar instance of this type, which has the advantage that the support gradually gets "formed," and supplies active material to replace that lost in the working of the cell.

In the new 1890 pattern E. P. S. plate, an early form, introduced originally by Swan, has been resorted to. The plate is grooved, but instead of the grooves being vertical, as in the Tudor plate, they are horizontal, and the ridges between the grooves curve slightly upward toward the surface of the plate, forming a lodgment for the paste.

2. The support is some form of "grid," that is, is perforated with holes, as in the old pattern E. P. S. plate, and the Julien grid, Fig. 2.

A great many varieties of this form of plate have been suggested, and the apertures have been made by casting the grid in a mold, and by punching. Their form has been cylindrical, barrel shaped as in Messrs. Drake and Gorham's positive plates, shaped like two cones joined at the apices, and to give greater security the perforation has been made to expand again just at the junction of the apices.

The construction of a mold to produce a perforation expanding inwardly is a matter of difficulty, and therefore the grids are sometimes cast in two halves and subsequently joined, as in the Gadot cell, Fig. 3. In the Correns cell, Fig. 4, much used in Germany, the grid takes the form of a double lattice.

3. The active material is inclosed in a perforated conducting retaining vessel.

In this case, also, the devices resorted to have been very numerous. Plain or corrugated sheets of lead have been

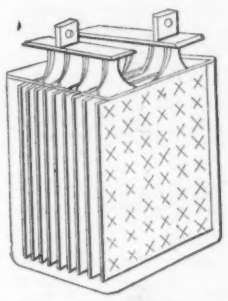


FIG. 5.—"ROBERTS" CELL, COMPLETE.

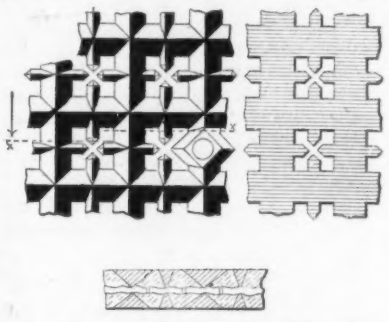


FIG. 6.—"ROBERTS" CELL: DETAIL OF PLATE.

taken and folded into boxes, either before or after applying the paste.

In the Roberts cell, Fig. 5, two grids are taken, pasted on one side, and then united to form a plate with the paste inside, Fig. 6.

4. In Dr. Tommasi's multitubular cell, Fig. 7, the retaining vessel may be constructed of metal, but is usually of some non-conducting material, and so comes under the next heading.

The enclosing vessel or plates are made of some non-conducting material, or some inactive material is packed between the plates to prevent short circuiting, and retain the active material.*

In France the plates have been covered with perforated sheets of celluloid; Reynier brought out what he called an

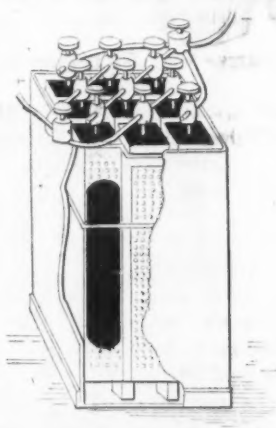


FIG. 7.—TOMMASI CELL, CORNER CUT AWAY TO SHOW INTERNAL ARRANGEMENT.

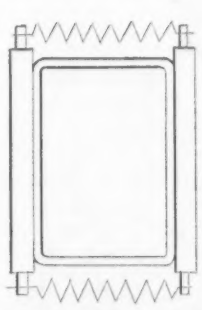


FIG. 8.—REYNIER ELEMENT: PLAN OF COMPRESSING ARRANGEMENT.

"elastic cell," specially designed for use on torpedo boats. When tried in 1886, on board La Gymnote, it was not a success, and the alkaline copper cell was preferred to it. Since, then, however, the construction has been much improved, Fig. 9. Each cell, according to improvements effected in 1889, is composed of one positive, two negative plates, and four porous partitions held together, as shown, by a frame consisting of two end plates connected together by corrugated strips of metal, which have sufficient elasticity to enable them to expand and contract with the alteration in volume of the plates caused by charge and discharge, Fig. 8.

In this country Mr. Barber-Starkey has tried filling in between the plates with a mixture of plaster of Paris and sawdust; Mr. Fuller uses porous pots; and in the United States, in the Pumpelly battery, cellulose, or wood pulp, is used to separate the plates which are arranged horizontally, as in the Atlas cell, Fig. 10.

b. Improved Connection Between the Applied Oxide and the Support.—With this object the support has been well rubbed with carbon before applying the paste, and the addition of carbon to the paste in some form has been frequently recommended, as, for instance, kneading the oxides into a paste with lead acetate.

In the Tudor cell, Fig. 11, the positive plates are first treated by Planté's process, to coat them with a layer of crystalline electrolytic peroxide. The grooves are then partially filled with a paste of peroxide of lead, and pressure is applied to the ridges to expand them and partially close the mouth of the grooves, Fig. 12.

The casting or welding of the applied oxide to the plate has also been tried, and to overcome the difficulty of getting the substances to blend into one another, caused by the great difference in their melting point, it has been sug-

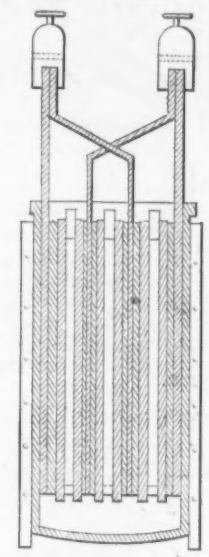


FIG. 9.—REYNIER ELEMENT: SIDE VIEW.

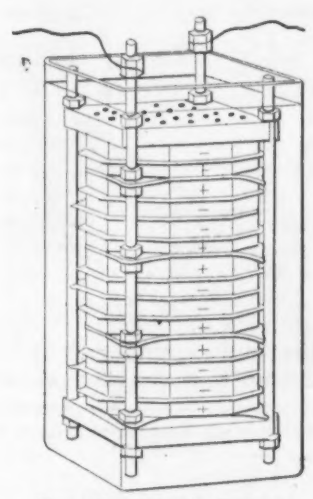


FIG. 10.—"ATLAS" CELL.

gested to fill the portion of the mold usually occupied by the support with some reducing agent, such as carbon mixed with nitre, so that when the fused oxides are poured into the mold they will be reduced in part to metallic lead, which will assume the place and shape of the carbon core, while the remainder forms the active material.

General Improvements.—Beside the improvements in what may be called the manufacture of the plates, or electrodes proper, various devices have been resorted to with the view of diminishing the resistance of the lugs, and securing better contact between plates of the same sign, such as making connection by tinned copper rods passed through holes in the lugs. Lead is afterward cast round

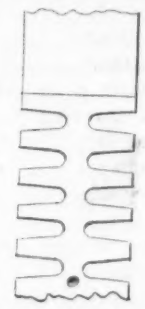


FIG. 11.—TUDOR PLATE: SIDE VIEW, EMPTY.

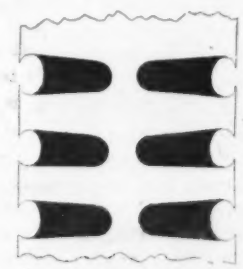


FIG. 12.—TUDOR PLATE: SIDE VIEW, EMPTY.

the copper, so that it is screened from the action of the acid.

Some attention has also been given to the question of the best electrolyte to use, some advocating the use of acid of density 1.150 to 1.180, while others recommend a density 1.200 and over. The addition of small quantities of some salt of the alkalies, such as sodium sulphate or carbonate, has been recommended by Mr. Barber-Starkey and others, with a view of reducing sulphating; and Dr. Paul Schoop has brought out a successful gelatinous electrolyte by adding one volume of dilute sodium silicate, density 1.180, to two volumes of dilute sulphuric acid, 1.250.

In order to prevent short circuiting between the plates by the material dislodged in working, they are now either

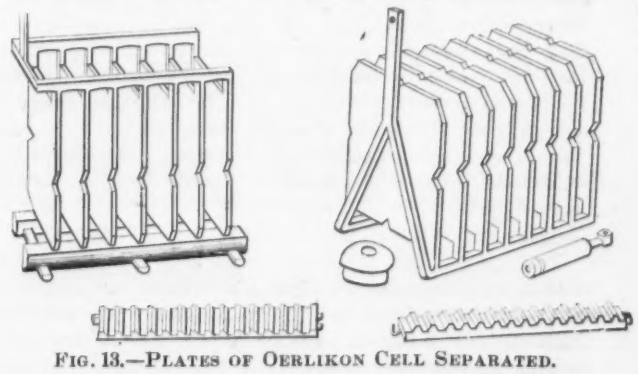


FIG. 13.—PLATES OF OERLIKON CELL SEPARATED.

slung, or rest on supports, which are so placed that the formation of a layer of mud between them is prevented.

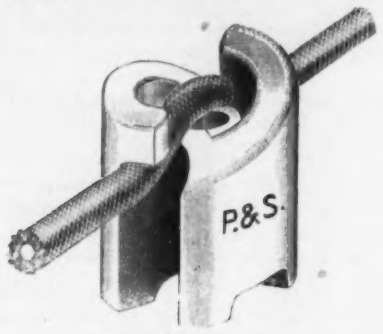
The equalization of the chemical action over the surface of the plates has also been attempted, and in the Schoop cell the current enters at the top of one set of plates and leaves from the bottom of the others. The plates also are widely spaced now as a rule, the proportion of acid to plates has been increased, and little alterations are constantly being made to secure the free circulation of the electrolyte essential to regular working (Fig. 13).

* Paper read before the Society of Arts, London.

* The improvements under this heading are equally applicable to cells of the Planté type; but as they are more frequently applied to cells of the Faure type, I refer to them under this heading.

A New Ceiling Insulator.

The new wiring insulator shown in the illustration on this page avoids the unsightly "tie wire," and does not injure the insulation or make any short kinks in the wire. It will be noticed that the wire passes through the centre of the insulator, which effectually prevents the insulator turning and throwing slack in the wire, as is the case when the wire is fastened to the side of the insulator. Wiring can be done very rapidly with it. The insulators are fastened to the ceiling and the wire passed under one lug and drawn taut, and then passed under the other lug, the slight



Ceiling Insulator.

bend in the wire holding it taut. The wire is held a good distance from the ceiling, preventing the deposit of dust.

An Adjustable Bell Sand Distributor.

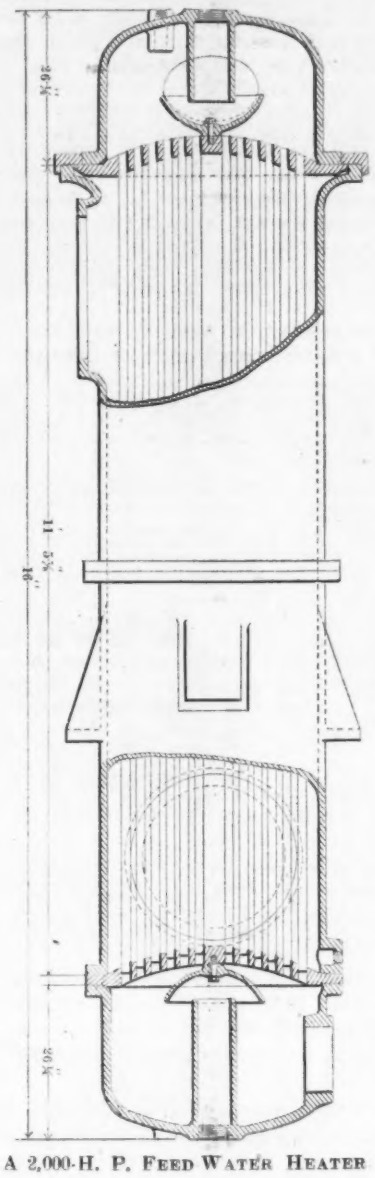
The illustration shows an instrument intended, by its adaptability to the work, to distribute sand over electric and cable car tracks, and is so constructed as to obviate the clogging of pipes by the pressure of water and snow, thereby making an even distribution. It is manufactured by the Reagan Manufacturing Company of Philadelphia.

The English Thomson-Houston Tramway.

Our English correspondent writes as follows: "The Thomson-Houston line at Leeds is already in difficulties with the National Telephone Company. Last week a deputation from the telephone company waited upon the Tramways Section of the Highways Committee of the Leeds Corporation and complained that the telephonic system on the Roundhay Park road was being seriously interfered with by the working of Mr. Graff Baker's cars. Several users of the telephone came forward in support of this statement, and alleged they were unable to hear anything that was said to them. Mr. Graff Baker merely stated that the wires were run and the cars were worked in exactly the same way as in America, and he presumably meant to infer that what was tolerated across the Atlantic might well be tolerated in the United Kingdom. The committee, having heard both sides, came to the sensible conclusion that it would be better to leave the two industrial enterprises to fight the matter out between them. It is to be hoped, however, for the sake of Mr. Graff Baker's spirited enterprise, that he will not have to bear unaided the full brunt of the wrath of such a rich corporation as the National Telephone Company."

A 2,000 H. P. Goubert Feed-Water Heater.

Owing to the tendency of steam users toward higher boiler pressure the accompanying illustration of what is thought to be the largest feed-water heater ever installed in a central station in this country will prove of interest. This heater does not very materially differ in outline from the well known heater made by the Goubert company except in details adapting it to stand the high pressure which the Edison Electrical Illuminating Company of this city intends to use in all its stations. These stations when complete will be models of high pressure steam engineering construction,



A 2,000-H. P. Feed Water Heater

the enormous triple expansion engines being connected direct to the dynamos. It is expected that an economy of one pound of coal per h. p. can be secured.

The construction of this heater can be readily understood by referring to the illustration shown on this page. It is essentially composed of two cast iron water chambers connected together by a cluster of seamless drawn brass tubes rigidly secured at their ends to a curved tube plate by means of a roller tube expander, in the same manner that boiler tubes are secured to their heads. It is held in position by having cleats or projections cast on the outer shell, which is made of cast iron, and these rest on substantial supports. It is so constructed that when set up it is free to expand in all directions. The tubes are well surrounded by a cast iron shell provided with inlet and outlet nozzles, to which is connected the exhaust pipe. The water inlet and outlet pipes are made to project inside of the water chambers and opposite them are placed dish shaped deflectors, the purpose of which is to deflect the flow of steam and thereby promote the separation of scum and sediment.

New Electric Bell.

A bell of rather novel construction is shown in the accompanying illustration. It is placed upon the market by the Time Electric Company, of Cleveland, O., and is made in four sizes, ranging from 2½ to 5 inches in diameter. As will be seen, the armature is placed at the side of the magnet coil and is parallel to the core. The bell occupies a minimum amount of space and is very easily put in place or taken down, as it is made to hang upon an ordinary screw. It is

New Type of Electric Bell.

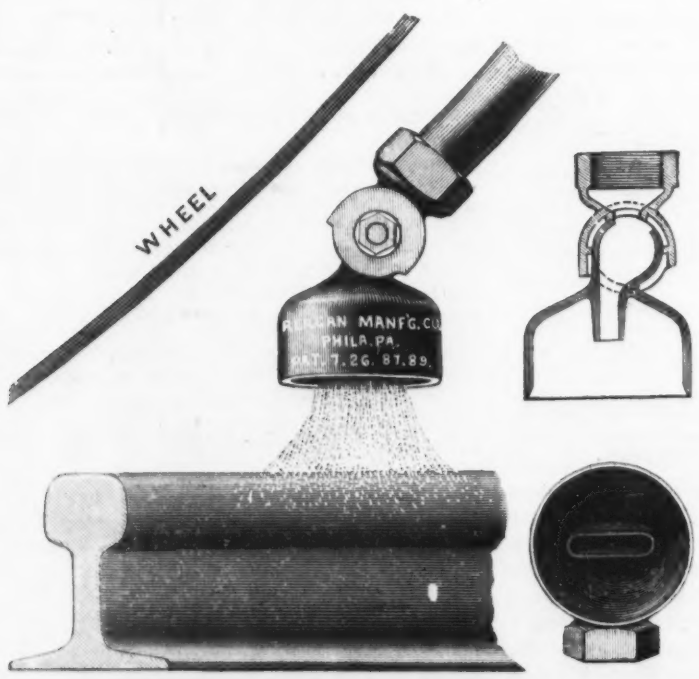
claimed that recent severe tests have shown it to be very efficient. It was found that no change in the adjustment was necessary whether one or a dozen cells of battery were used.

Otis Electric Pump.

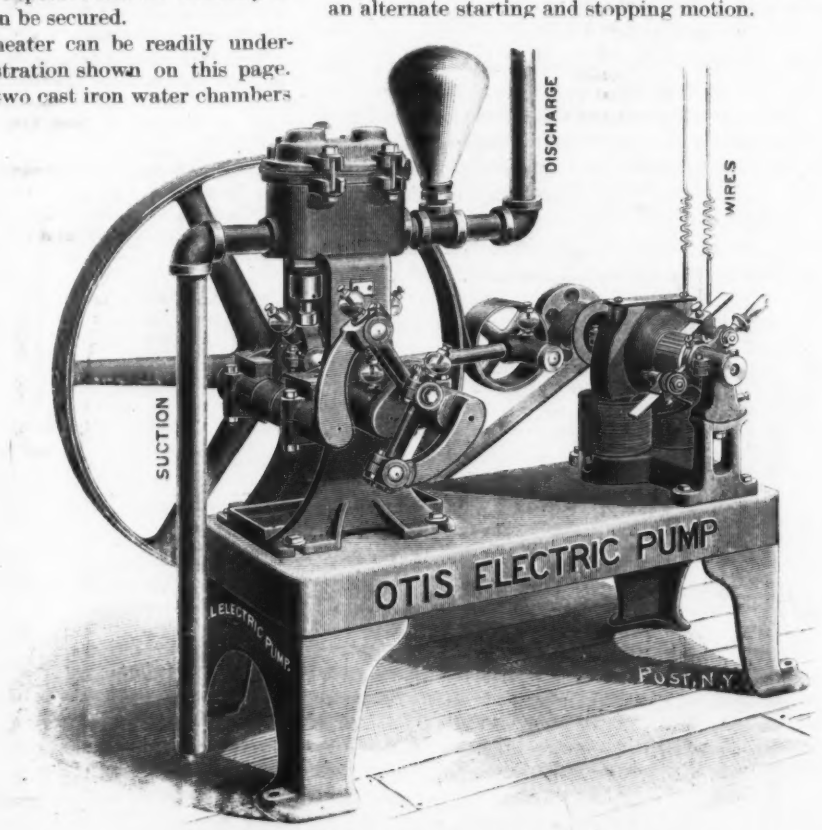
To supply the demand for an electric pump, and to fully meet the exacting requirements of this service, Otis Brothers & Co. present to the public the latest improvement in this class of machinery, viz., the Otis Electric Pump.

It is constructed to operate upon a novel principle, the water being moved with a continuous and unvarying flow, entering at the suction and passing through valved pistons, thence out at the discharge.

Among the advantages claimed for this principle of action are its entire freedom from the shock, jar, or water hammer usual in many styles of pumps; the economy in power naturally resulting from the constant motion of the column of water, as it does not require as much power to keep a body in constant motion as it does to move it with an alternate starting and stopping motion.



SAND DISTRIBUTOR FOR STREET RAILWAYS.



NEW OTIS ELECTRIC PUMP.

Another advantage arising as a natural result of the continuous action is the even distribution of the work at all points of the revolution of the pump, thereby creating a uniform resistance to the action of the electric motor.

For domestic use and other light services they are eminently adapted to supersede all of the other troublesome and objectionable devices (with their disagreeable features), such as steam, gas, oil, hot air engines, etc., wherever it is possible to connect with the lines of the electric lighting or power circuit.

It is automatic in its action and always keeps the tank full without requiring attention or the services of an attendant, as there is placed at the tank and in the electric circuit a switch or cut-out, which is operated by the action of a float as it rises and falls with the water.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

The Closing Quotations of electric stocks on Saturday, Jan. 9, 1892, in New York and Boston were:

Name of Stock.	Par.	Capitalization.	Bid.	Ask'd.
Western Union Telegraph Co	100	86,200,000	83	83
American Telegraph & Cable	100	14,000,000	81	82½
Central and South American	100	5,000,000	....	....
Mexican	100	2,000,000	....	....
Commercial Cable Co	100	7,716,000	149½	151
Postal Telegraph Cable	100	5,000,000	....	....
Edison General Electric	100	15,000,000	94¾	96
Thomson-Houston Electric Co	25	6,000,000	58⅝	51
" " preferred	25	250,000	26⅜	26½
" International Electric Co	100	1,000,000	175	200
Thomson Electric Welding Co	100	1,000,000	40	45
" European Electric Welding Co	100	1,500,000	14¾	15
Westinghouse Electric Co., assented	50	10,000,000	13½	13¾
Fort Wayne Electric Co	25	4,000,000	12⅛	12⅜
Detroit Electrical Works	10	1,0 0,000	8¾	9
Pettingell-Andrews	25	200,000	....	....

Chicago Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on electrical stocks as follows:

TELEPHONE STOCKS.

Chicago	$224@	$226	Cumberland	$60@	$62
Central Union	52@	53	Wisconsin	118@	120
Michigan	81@	83	Bell of Missouri	175@	180
Great Southern	30@	32	Missouri & Kansas	54@	56
Colorado	34@	36	Iowa Union	20@	22
Rocky Mountain Bell.	40@	43			

ELECTRICAL STOCKS.

Chicago Arc Light and Power	$80@	$81	Chicago Edison Co	$139@	$140

NEW INCORPORATIONS.

The S. H. Warfield Company, of Baltimore, Md., with a capital stock of $100,000, has been formed to manufacture machines and electrical apparatus. The organizers are S. D. Warfield, C. Shriver and C. Jenkins.

The Electric Light Company of Kirksville, Me., capital stock $15,000, has been formed to establish and operate an electric light plant. J. Caskey, S. M. Pickler and J. C. Carethers, all of Kirksville, are the incorporators.

The Sea Medicine Company, of Chicago, Ill., capital stock $20,000, has been formed to manufacture and sell medicines and electrical appliances. Leon M. Conroyd, Frederick A. Follette and Harry W. Martyn are the incorporators.

The Charleston Electric Light Company, of Charleston, Me., capital stock $6,000, has been organized to establish and maintain an electric light plant. A. Alexander, A. H. Danforth and A. Orr, all of Charleston, are the incorporators.

The Edison Sault Electric Company, of Sault Ste. Marie, Mich., capital stock $50,000, has been organized to supply electric lights. The incorporators are Harris T. Dunbar, William Chandler and Minnie C. Dunbar, all of Sault Ste. Marie.

The Lancaster and New Holland Electric Railway Company, of Lancaster, Pa., with a capital stock of $150,000, has been started to operate an electric railway. John H. Kertzler, D. Blair Shenk and Frank Eshleman are the incorporators.

The Logan Electric Light Company, of Logan, Ill., with a capital stock of $20,000, has been formed to generate and transmit electricity for light and power. John Hansen, Jno. F. White, J. A. Stiers, W. W. McCray, and F. S. Case are the promoters.

The National Storage Battery Company, of Troy, N. Y., capital stock $5,000, has been incorporated to manufacture and sell storage batteries and other electrical appliances. The organizers are Wm. H. Hollister, E. G. Bernard, and W. D. Weaver, all of Troy.

The Troy Electric Light and Power Company, of Troy, Pa., with a capital stock of $10,000, has been organized to supply light and power by means of electricity. B. B. Mitchell, Daniel Flecher, John Parsons, Frank Loomis and A. C. Fanning, of Troy, are the incorporators.

The Helena Rapid Transit Company, of Helena, Mont., capital stock, $500,000, has been formed to build and operate a power plant, an electric light plant, and to construct and operate street railways. The promoters are J. H. Lawrence, W. H. Clark and A. Barbour, all of Helena.

The Cortland & Homer Electric Company, of Cortland, N. Y., capital stock $50,000, has been formed to manufacture and use electricity for light, heat and power. C. B. Hitchcock, of Tallapoosa, Ga., and F. B. Hitchcock and H. Welles, both of Cortland, N. Y., are the promoters.

The Hart & Hegeman Manufacturing Company, of Hartford, Conn., with a capital stock of $20,000, has been started to manufacture all kinds of electrical machinery and novelties, etc. Geo. S. Hegeman, of Windsor, Conn., and Alfred H. Pease, of Hartford, Conn., are interested therein.

The Louisville Electricity Company, of Louisville, Ky., capital stock $25,000, has been formed to manufacture and sell electrical appliances, build electrical elevators, and conduct a general repair shop. Henry Donigan, J. W. Dawer, and Joseph Meyrick, Jr., all of Louisville, Ky., are the organizers.

The R. B. Electric Supply and Construction Company, of New Whatcom, with a capital stock of $1,000, has been incorporated to deal in and operate electrical plants, machinery, supplies and fittings, etc. O. E. Berg, Lewis Stenger and D. R. Myers, of New Whatcom, Wash., are the promoters.

The Davenport Power and Light Company, of Davenport, Ia., with a capital stock of $50,000, has been incorporated to construct and operate a power, light and heating plant. Wm. L. Allen, Thomas O. Swiney, B. E. Sunny, Henry S. Manning, and James S. Cummings, all of Davenport, are the promoters.

The Duquesne Heat, Light and Power Company, of Duquesne, Pa., has been incorporated with a capital stock of $20,000, to supply heat, light and power by means of electricity to the public in Mifflin township, Allegheny County, Pa. Wm. B. Bath, M. G. Conlin, C. W. Allbrand and H. T. Black are the promoters.

The Ozone Park Electric Light and Power Company, of Jamaica, N. Y., capital stock $2,000, has been organized to manufacture and use electricity for light, heat and power. John N. Williamson, of Ozone Park, L. I.; Henry C. Rath, of Flushing, L. I., and David B. Emmons, of Brooklyn, N. Y., are the promoters.

The Suburban Electric Company has filed articles of incorporation at Elizabeth, N. J. The capital stock is $300,000, the company beginning business with $50,000 paid in. The incorporators and stockholders are Alden M. Young, J. K. Smith, of Waterbury, Conn.; Henry Hayes, of Newark, N. J., and James M. McGiffert, of Elizabeth.

The North Baltimore Electric Light and Power Company, of North Baltimore, O., with a capital stock of $50,000 has been organized to operate an electric light plant for illuminating purposes and furnish electric and motive power. A. G. Henry, W. S. Coon, W. H. McMillen, L. Wooster and D. E. Peters are the promoters.

The Montana Mining, Loan and Investment Company, of Butte, Mont., capital stock $12,000,000, has been formed to purchase and sell real estate, mines, quarries, etc., and for electric lighting, etc. The organizers are Henry L. Haupt, Harry C. Kessler, J. E. Richards, H. G. Valiten, Jno. F. Cowan, P. A. Largey, M. L. Holland, Chas. J. Stevenson, all of Butte.

The Hall Chemical and Gas Company, of Chicago, Ill., with a capital stock of $1,500,000, has been organized to manufacture oil, gas, etc., own mining property, to operate, smelt and refine ores, etc., manufacture and sell machinery and appliances for electrical and other purposes. A. H. Harryman, John Schwender and Sidney C. Eastman are the promoters.

The Electric Power Transmission Company (incorporated in West Virginia and having its principal office in Boston, Mass.) has been incorporated with a capital stock of $500,000, to buy, sell, etc., water powers and electric plants of all kinds, and operate same. F. C. Todd, Chas. S. Knowles and Arthur L. Woodman, all of Boston, are the promoters.

The Grand Rapids Water Power and Boom Company, of Grand Rapids, Minn., capital stock $50,000, has been organized to construct and maintain dams, booms, canals and mills across the Mississippi River and tributaries; and for the construction of electric light plants. The incorporators are J. R. Hawes, of Brainard; J. Grant, of Faribault, and C. A. Long, of Duluth.

The Neutral Storage Battery Company, of Newark, N. J., capital stock $300,000, has been incorporated to manufacture and sell batteries for the storage of electricity, etc. G. W. Harris, G. Huerstel, H. L. School, E. Hall, A. Fogal, all of New York; E. C. Harris, Newark, N. J.; M. H. Chase, Hilton, N. J.; B. G. Field, Rahway, N. J., and P. A. Harris, of Paterson, N. J., are the promoters.

The Glennan Improvement Company, of Port Townsend, Wash., with a capital stock of $100,000, has been incorporated to deal in and improve real estate, operate wharves, docks, railways, grain elevators, machine shops, gas and electric light works, etc. Wm. Payne, A. H. Glennan, F. Bradshaw, L. C. Coleman, E. E. Hickman, L. T. Seavey, Leslie Cullern, J. Sheehan and Jno. A. Plum, of Port Townsend, Wash., are among those interested.

AFFAIRS OF THE COMPANIES.

The Sunbeam Incandescent Lamp Company, of Chicago, has certified to an increase in capital stock from $103,000 to $200,000.

The Great Western Electric Supply Company, of Chicago, has declared a quarterly dividend of two per cent. on its preferred stock.

The Edison General Electric Company will pay a dividend of two per cent. Feb. 1. The annual meeting of the company set for Jan. 8 has been postponed to Feb. 10.

Worcester, Mass.—A special meeting of the stockholders of the Worcester Consolidated Street Railway Company has been called to increase the capital stock from $350,000 to $750,000 for the purpose of paying off its indebtedness and making extensions.

The Thomson-Houston and the United States Electric Light and Power companies, of Buffalo, N. Y., have consolidated their interests, to go into effect Feb. 1. The title of the company will probably be changed to the Buffalo Electrical Company. It is stated that both plants will be maintained and operated practically as at present, the change being made in the interests of economy.

Two trust deeds have been given by the Georgia Electric Light Company, of Atlanta, Ga., and by the Edison Electric Illuminating Company, of Atlanta, the former to secure the first mortgage 6 per cent. bonds of the company, by which it is authorized to issue $500,000 in bonds to mature in 30 years. The latter is to enable the company to float first mortgage bonds amounting to $50,000.

The eighth annual report and balance sheet of the Allgemeine Electricitats Gesellschaft, of Berlin, recently published, shows that it is not only a great manufacturing concern, employing upward of 1,500 hands, but that it also invests large sums of money in a variety of electrical enterprises. The net earnings of the past year were $559,140. Out of the profits the company last year considerably augmented its plant, tools and buildings. The output of the incandescent lamps which it manufactures is now 1,000,000 per annum. In addition to several new types of dynamos, a series of different sizes of electric motors have been developed during the past twelve months. A concession has been obtained for utilizing water falls on the Rhine, aggregating 12,000 h. p., which will be transmitted electrically to important industrial centres in Germany.

The Thomson-Houston Electric Company, states the Boston *News Bureau*, has purchased 18 acres of marsh land upon the Saugus River between the Eastern Railroad and the Lynn turnpike, where it will establish a power station, taking coal direct from vessels and transmitting power by electricity to the company's factories at Lynn. This will relieve the Lynn grounds of the steam plant and give room for much needed extension of the factory work. No plans have yet been adopted, it is stated, concerning the establishment of a Thomson-Houston plant in Chicago. Mr. Pullman desires the erection of the new Thomson-Houston works at the city of Pullman, while other interests are making handsome offers for a location upon their lands near Chicago. Nothing has been determined yet as to the extra dividend to Thomson-Houston stockholders to represent the million dollars surplus earnings over dividends for the present year. The Thomson-Houston could very nearly pay it in cash at the present time, as it has $750,000 on hand.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Jan. 11, 1892.

Mr. H. K. Gilman, of the Great Western Electric Supply Company, of Chicago, is in New York on a business trip. He reports business as good with his company.

Mr. M. F. Adams, of the cable and wire department of the Edison General Electric Company, has returned from a 30 days' business trip through the South. He reports business in his line as good and the prospects promising for the future.

The Manhattan Electrical Supply Company, of 36 Cortlandt street, New York, is meeting with very gratifying success in the sale of its "Mesco" dry battery and has established agencies among several of the largest supply houses throughout the country.

Mr. E. W. Little, general manager of the Interior Conduit Company, is again at his desk after a long and tedious illness. As soon as he was able Mr. Little made a trip through the South, which did him so much good that he is at present feeling better than he has for many years.

Mr. W. Dwight Wiman, son of Erastus Wiman and General Manager of the Richmond County Heat, Light and Power Company, of St. George, S. I., met with an accident Saturday, Jan. 9, while assisting in extinguishing a fire which broke out in the office of the electric light works. He received a painful cut in the left foot.

The C. & C. Motor Company is unusally busy and has of necessity been compelled to manufacture a great many of its larger machines outside of its regular factory. This company has always been in the foremost rank in the matter of new applications of motors, and its present large business is the result of its aggressive policy.

The Electric Light Companies recently conferred with the Mayor in regard to the poles and wires which the Board of Electrical Control ordered to be taken down within ninety days from Oct. 12. The result of the conference was that the companies agreed to have all the poles down by the middle of this month at their own expense.

American Institute of Electrical Engineers.—The sixty-third meeting of the American Institute of Electrical Engineers will be held at 12 West Thirty-first street, New York, Tuesday evening, Jan. 19. A paper will be read by Mr. Chas. P. Steinmetz, of Yonkers, N. Y., on the "Law of Hysteresis." Advance copies of the paper are in preparation, and will be forwarded to such members as desire them.

The Electric Construction and Supply Company, of 18 Cortlandt street, reports that business never was as good as during last month. Ward arc lamps were in great demand, within three days orders having come in for 100 lamps for isolated lighting plants, 200 for Chicago, and 150 for central station work, beside a large number of orders for photo-engraving and search light lamps.

Mr. A. B. Laurence, of 225 Pearl street, New York, who represents the Shultz Belting Company in this vicinity, has made recent sales as follows: Benson Mines, New York; Rahway Electric Light Company, Rahway, N. J.; Edison Mines, Ogden, N. J.; East River Electric Light Company, N. Y.; Inman Line Electric Light plant; Johnson Switch and Signal Company, Steamer Westernland Electric Light Plant, Union County Electric Light Company, Roselle, N. J.; Delhi Electric Light Company, Delhi, N. Y., and 10,000 feet to Edison General Electric Company.

The W. S. Hill Electric Company gave an "at home" to its friends at the New York office, in the Electrical Exchange Building, on Jan. 4. The genial and hearty manner with which Captain Des Marets, who is New York agent of the company, received and entertained the guests of the occasion left an impression of kindly feelings not soon to be forgotten. An elegant collation was served, which was interspersed with expressions of best wishes and congratulations on the success attained by the W. S. Hill Electric Company, one of the most representative in its line of business in the country. The "at home" was given at midday, and served as a happy relaxation from business cares, when friend could meet friend, with that hearty handshake and enjoyment of good cheer which serves to prove this life worth the living. Miss Anna Millbank and Mrs. Captain Des Marets were the only ladies present.

L. H. H.

ALBANY, Jan. 9, 1892.

The incandescent lights of the Little Falls Electric Light Company were started burning Wednesday for the first time.

The Telephone Company of Troy has made application to the Common Council for a franchise permitting the company to lay wires underground throughout the city.

The Saratoga Gas and Electric Light Company has accepted the proposition of the street commissioners, which calls for 100 arc lights, 220 gas lamps, and 90 naphtha lamps, at an aggregate price of $20,000 per annum, payable in monthly installments. The proposition covers only street lighting.

The Lamp and Gas Committee of the board of trustees of Lansingburgh was to have met on Tuesday evening to consider the proposition to light the village by electricity. Mr. Rochester, the chairman of the committee, who is preparing estimates of the cost for electric lighting and the number and location of the lights was not ready to report, and the meeting was adjourned until Friday night. The agitation in favor of electric lighting is the outcome of the resolution presented to the trustees by the police commissioners, recommending that steps be taken to light the village by electricity. It is stated that the cost of electric lighting will be about $12,000 annually.

At the first day's session of the Legislature the following were among the bills introduced: Assemblyman Webster—last year's bill compelling street railways to pave between the rails; also, empowering the Commissioners of Public Works in New York to specify the styles of rails that shall be used in streets. Senator Plunkett introduced a bill allowing passengers on the Manhattan Elevated Railroad, who have paid the regular fare below 129th street and east of Broadway, in New York City, to ride without additional charge on the cars of the Suburban Rapid Transit Company within city limits. Assemblyman Stein—permitting the presence of six newspaper reporters at electrocutions in this State.

R. V. T.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
927 CHESTNUT STREET, PHILADELPHIA, Jan. 9, 1892.

An Electric Club for Philadelphia.—As quite a large number interested in the electrical field in Philadelphia are anxious to establish an electrical club for this city, one that will be a credit to Philadelphia, we wish to further their desire, and hope to see Philadelphia's electric fraternity take hold and establish a club on such a firm basis that its future success will be assured. Will all who would like to participate in the forwarding of this scheme please send their names to the "Electric Club," City Trust Building? If one hundred names are received, each party will be notified to attend a meeting at some hotel or other designated place.

Mr. Harback, well known in the electrical line in Philadelphia, has been very ill with la grippe. It is expected he will get around shortly.

Mr. Otis K. Stuart, the enterprising agent for the Germania Electric Company, is now settled in new headquarters in the City Trust Building.

L. F. Seyfert & Sons, of Philadelphia, who deal extensively in machines, report a growing demand for engines adapted to electric lighting purposes.

The Imperial Electric Company, of Philadelphia, reports business for the past week as very good, some of its orders coming from as far as Canada.

The Century Pottery Company, of Camden, N. J., reports business in a flourishing condition. It is doing as much as the capacity of its works will permit.

Mr. J. Comly, well known in electrical circles in Philadelphia, has recently sold his interests in the various enterprises he has been

connected with and will leave for Florida in order to regain his lost health.

Mr. Pepper, of the firm of Clay, Pepper & Register, is now recovering from a severe illness. Some most important work has been laid aside by the above firm on account of Mr. Pepper's condition. On his resuming his business, they hope to rush to completion all work under construction.

In the injunction suit recently brought against the city to prevent the awarding of electric light contracts, Judges Finletter and Gordon have dissolved the injunction granted on the petition of the Philadelphia Illuminating Company as a bidder for the contract, and the awards which were made by Director Windrim will not be interfered with. W. R. W.

WESTERN NOTES.

Branch Office of The Electrical World,
465 The Rookery, Chicago, Jan. 9, 1892.

Mr. John R. Markle, of Detroit, was in Chicago this week.

Mr. George Mayo, of the Rockford (Ill.) Electric Manufacturing Company, dined at the Chicago Electric Club this week.

Mr. Crompton, of the Economic Electric Manufacturing Company, of Boston, was a welcome visitor in Chicago this week.

Mr. B. Fleming, formerly representing the Edison General Electric Company, of Portland, Ore., is now located in Chicago.

Mr. W. B. Roberts, the new manager of the Rockford Electric Manufacturing Company, dined at the Electric Club this week.

Mr. H. C. Tanner, of Kaukauna, Wis., is in Chicago arranging to dispose of the bonds of the Kaukauna Electric Light and Power Company.

Mr. W. L. Adams has been elected secretary and treasurer of the Electric Merchandise Company, of Chicago, vice Mr. A. H. Englund, resigned.

Mr. J. T. Hamby, of the Beacon Vacuum Pump Company, of Boston, stopped over in Chicago for a day or two while returning home from Denver and the West, where he has been doing good work in introducing his lamps.

The American Electric Works, of Providence, R. I., have been favoring their Chicago friends with decks of playing cards of extra fine quality, possibly as a hint that the Windy City can secure that five million dollar appropriation from Congress if the proper cards are played.

Obituary.—Miss Ida N. Berentson, the private secretary of Mr. Franklin S. Terry, died at the residence of her parents, after a short illness, on Monday morning, Jan. 4th. Occupying for more than two years an important position and intrusted with work requiring the utmost care and attention she never failed to carry through to completion whatever was allotted to her, and no matter how great the press of business was ever ready to lend a helping hand and to greet with a smile and a pleasant word every one who called on her. Mr. Terry and his staff feel most keenly the sudden departure of one whom they all held in the highest esteem.

Sorrow Never Cometh Singly.—This saying was most deeply realized at the office of The Electrical Supply Company, on Monday, when a message came in saying that the residence occupied by its city salesman, Mr. George Carter, was destroyed by fire. A few moments later came the notice of the death of Mr. F. S. Terry's private secretary, Miss Ida N. Berentson, a most estimable young lady; then came a note announcing the death of Loraine, the two-year old daughter of Wells Goodnue, manager of the electric light department, followed by a message to Advertising Manager Goe, carrying the sad news of the death of his father. Truly a remarkable succession of sad occurrences. F. De L.

Lincoln, Neb., Jan. 9, 1892.

Fairbury, Neb.—The electric light plant is being pushed along rapidly by the Thomson-Houston company, which has secured the franchise for lighting the city.

Lincoln, Neb.—The business houses in the different parts of the city are putting on their holiday attire, and the electric light is taking a foremost place in the decoration of windows, effects, etc.

Schuyler, Neb.—At a special election in this city recently for the purpose of voting upon a proposition to issue $7,500 electric light bonds the measure was carried by 186 majority. The bonds will run 10 years and draw 7 per cent. interest.

The Line In Electric Manufacturing Company has secured the contract for lighting the Nebraska City Starch Company's mills. The work is progressing rapidly. J. H. Rush has secured the contract for lighting the Home for the Friendless at Lincoln.

At Wymore, Neb., a short time ago, a short circuit occurred at the brushes of the dynamo, causing the sparks to fly somewhat. The ingenious local reporter describes the affair in this luminous manner: "At the electric light station last evening quite an electrical phenomenon occurred. Everything was still upon the night air, when suddenly a flash was seen at the dynamo station. Upon investigating the matter, it was found the electric machine had bursted with great violence, hurling ampères to the right and left, and two volts burning their way through the floor, making a hole large enough to place a person's hand through." H. A.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 28, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., Jan. 9, 1892.

C. S. Knowles & Co.—Mr. C. S. Knowles has gone to Bermuda, intending to remain until spring.

Mr. H. K. Porter, 66 Beverly street, Boston, reports continued success with his "Easy" wire cutter, which has only to be seen to be appreciated.

The Electric Gas Lighting Company has just issued its 1892 catalogue, which is the neatest it has ever issued, and should be in the hands of every one in the trade.

The Telephone Employees Mutual Benefit Association hold their annual ball at Oddfellows' Hall, Thursday evening, Jan. 21, and a large attendance is expected.

The Massachusetts Electrical Engineers' and Mechanics' Association hold their second annual ball in Oddfellows' Hall, Boston, Feb. 2, and preparations are being made for a grand affair.

In the Bell telephone case the government's testimony before the examiners appointed by the Circuit Court in Boston will be in on Monday, Jan. 11, Justice Colt having granted an extension until that time.

The Eastern Electric Supp'y Company.—Mr. Alphonse Martin, formerly superintendent of the Lynn Belt Line, will hereafter look after the railway department of the E. E. S. Company in New England. Mr. Wallace will devote his whole attention to the West.

The Boston Electric Club.—Mr. R. F. Ross, secretary of the club, is sending out circular letters stating the proposed revision of the constitution and by-laws; also a general invitation to the inaugural dinner for the year 1892, which will be held at the Parker House on the evening of Jan. 11.

The Electric Gas Lighting Company has finished its inventory and reports a gross increase in business of 30 per cent. over any previous year. This speaks well for the management and reflects no little credit on Manager L. G. Burnham, who has labored so faithfully to accomplish this result.

The Electric Mutual Insurance Company, which began business on May 15, 1890, for the special purpose of guaranteeing indemnity for loss by fire to electric lighting stations, has closed up its business. The entire outstanding business of the company has been reinsured in the Home Insurance Company, of New York, it is stated.

The Beacon Vacuum Pump and Electrical Company is receiving many unsolicited testimonials from users of its new lamps, and has been unable to keep pace with orders. This speaks volumes for a lamp exhausted by a mechanical pump which it was claimed so persistently could not be done. A visit to the factory on Irvington street would prove very interesting.

The Wainright Manufacturing Company has sold during the month of December feed water heaters aggregating nearly 10,000 h. p. to 60 different companies, including Goshen Electric Light Company, Goshen, N. Y.; Newport News Electric Light Company, Newport News, Va.; Wilmington City Railway, Wilmington, Del.; Derby Street Railway Company, Derby, Conn.; Ashland Street Railway Company, Rappahannock, Pa.; Montana Electric Railway Company, Helena, Mont., etc. They also report large sales of their well-known expansion joints.

Fenders for Electric Cars in Boston.—The refusal of the city government to co-operate with the West End Street Railway Company in the appointment of a commission to determine upon the best form of fender to be attached to electric cars has led to the company appointing a commission on its own responsibility. According to public announcement, this commission is composed of Thomas C. Clark, C. E.; A. Bartlett and George F. Swain. Mr. Bartlett is the treasure of the Boston & Lowell Railroad, and lives in Chelmsford; and Mr. Swain is a bridge engineer connected with the office of the Board of Railroad Commissioners. C. A. B.

CANADIAN NOTES.

Ottawa, Jan. 9, 1892.

The Citizens of Hamilton will be the recipients of a rare treat this coming summer, when the first electrical convention and exhibit of the Canadian Electrical Association will be held. The event will come off on the second Tuesday in June, and promises at least a three or four days' exhibit of running electrical apparatus, which will be free to the general public, and will bring the city some 300 or 400 visitors.

St. John, N. B.—The electric light service of the city is to be improved. A recent consolidation of the western and New Brunswick companies, it is believed, will bring about an improvement in the service, and the cost of the production of the light will be reduced. Arrangements have been made with H. Ward Leonard, of New York, of H. Ward Leonard & Co., to come to St. John and inspect the entire equipment of the plants, with a view of remodeling and perfecting the system. Early in the spring, it is stated, extensive improvements are contemplated, which will include the necessary power to operate street car service, and what ever other electrical service may be required.

Ontario.—No province of the Dominion can show a more rapid development of electrical appliances than the province of Ontario within the past two years. The reports of the electric light inspectors of the Canadian Fire Underwriters' Association show that there are now in use 3,500 miles of electrical circuits, 400 dynamos, 200 motors, and that 12,000 arc lights and 33,000 incandescent lights are burning nightly in Ontario. One inspector reports that there appears a sincere desire on the part of the larger and more responsible construction companies to co-operate heartily with the underwriters in securing a high degree of efficiency of work and durability of material. It has been found that the greatest difficulty in securing good work arises from the fact that inexperienced people attempt to place small plants in a few towns and villages, offering to do the work so cheaply that it is not possible for them at the price to furnish proper material, or make a good safe job. It is from such imperfect work that the danger from fires arises. F. R. B.

News of the Week.

THE TELEGRAPH.

The New England Printing Telegraph Company has opened for regular telegraph business between Boston, Providence, Woonsocket and Danielsonville. The offices of the company are as follows: 99 Milk street, Boston; 19 South Water street, Providence; office of the Woonsocket *Reporter*, and Quinebaug Store, Danielsonville; where messages will be received for transmission, and delivered throughout the cities by messengers.

THE TELEPHONE.

Atlanta, Ga.—The building for the Atlanta Telephone Exchange will cost $70,000. Plans were prepared by Architect Nixon.

Bell Telephone.—We are able to announce, says the Boston *News Bureau*, that the American Bell Telephone Company has so far forwarded its experiments in the telephone field that it has now in its possession a perfected telephone by which whispers can be transmitted 500 miles as distinctly as though that 500 miles of wire were only five feet of space. Telephone connections between Chicago and the East will be only a matter of line construction. In fact, telephoning from Boston to San Francisco does not seem an impossibility in the near future. There are still difficulties of construction to be overcome for a cable telephone service.

THE ELECTRIC LIGHT.

Cambria, Va.—An electric light plant will be erected by J. Rigby.

Calvert, Tex.—An electric light plant is in contemplation by Allen, Collatt & Fuller.

Suffolk, Va.—The capacity of the Suffolk Light and Water Company will be enlarged.

Havana, N. Y.—Dr. C. D. Clauson is making arrangements to erect an electric light plant.

Oxford, Ala.—Philadelphia parties are negotiating for the erection of an electric light plant.

Dayton, Tenn.—A contract has been awarded to Burkhalter & Gibson to erect an electric light plant.

Rochester, N. Y.—The Rochester Electric Light Company has a new 1,500 light alternator in operation.

Wilmington, N. C.—An incandescent electric light plant will be put into the Wilmington cotton mills.

Vicksburg, Miss.—The city has awarded a contract for electric lighting to the Hill City Electric Light Company.

Charleston, S. C.—The erection of an electric power plant is contemplated by the West End Railway Company.

Radford, Va.—An electric light plant is to be put into the works of the Radford Pipe and Foundry Company.

Petersburg, W. Va.—New machinery will be put in the plant of the Upper Appomattox Electric Light Company.

Ellicott City, Md.—An electric light plant will be put in the McCrea mill property by parties who have leased the same.

Wytheville, Tex.—An electric light plant will be built by James Rigby, for the purpose of lighting the cities of Wytheville and Cambria.

Harriman, Tenn.—The city is considering the advisability of erecting its own electric light plant and water works. W. H. Parsons, city clerk, may be addressed.

Summerville, S. C.—Contract has been closed with F. W. Wagner, of Charleston, S. C., for an isolated incandescent electric light plant in the Dorchester Hotel.

Berkeley, Cal.—A. A. Osborne has been granted the contract to put up poles, wires, etc., necessary for the extension of the electric lighting system to the annexed district of South Berkeley.

The Citizens' Electric Light Company, of Braddock,, Pa., is increasing its power by the addition of a 150 h. p. Ball engine built by the Ball Engine Company, Erie, Pa., and sold by Dravo & Black, the Pittsburgh representatives of the company.

The Badger Illuminating Company, of Milwaukee, Wis., has at last been granted the right to do the city lighting for four years, the injunction which has been pending for some time having been dissolved. The price paid by the city is $110 per light per year.

Nevada City, Cal.—The New Castle Electric Light Company, K. Casper, proprietor, has been awarded a contract for one year for introducing in Nevada City an electric light plant of the Heisler system. The motive power for the new plant will be a Pelton water wheel.

The Washington Electric Light and Power Company, of Washington, Pa., has removed into its new station, which is a 50 × 105-foot one-story brick building, and built practically fireproof. This plant at present consists of three 100-h. p. Westinghouse compound and one 50-h. p. Junior automatic engines, also one 150 h. p. horizontal high speed Seymour and one 100-h. p. Ball engine. The generators consist of one 60-light alternating arc, one 250 and one 500-light Westinghouse alternator, one 1,300-light Slattery incandescent machine with exciter mounted on same base and two 80 h. p. U. S. generators. The company has an excellent boiler capacity, far beyond what is at present required to do the work. Natural gas is the fuel used. Current is furnished for from 1,400 to 1,700 lights, nightly, and runs the 60-light arc machine to its full capacity on the street lighting contract. Since the company started up its first dynamo in March of 1890, it has had exceptionally good luck. It is under the superintendency of Mr. H. Chambers and the thoroughly efficient engineers, Messrs. Jennings and Clarke.

The Pittsburgh Branch of the Thomson-Houston Electric Company has the station of the Irwin (Pa.) Electric Light and Power Company fitted up in excellent shape and every part moves as smoothly as could be desired. The local company, of which Mr. Samm is the general manager, is now the owner of a fine new 250-h. p. compound engine and 1,350 Thomson-Houston alternating dynamo of the latest and most efficient type, with a separate exciter of the motor type. The machine is belted to a friction clutch pulley. The present machine is loaded to almost its full capacity and another alternating dynamo will be secured and set up at an early date. The station was set up entirely under the personal supervision of Mr. George Gallant, of the Thomson-Houston Company. He is also about completing the installation of an isolated plant in the immense works of the Pennsylvania Plate Glass Company, which includes two 450-light direct current spherical armature Thomson-Houston machines, which are to be driven by a 125-h. p. Buckeye engine belted directly to the machines A number of Thomson-Houston arc lamps will be suplied with current from the incandescent circuits.

THE ELECTRIC RAILWAY.

North Highlands, La.—Cars have commenced running on the North Highlands Electric Line.

The new electric line between Buffalo and Tonawanda, N. Y., has been successfully opened for traffic.

Tampa, Fla.—The building of an electrical road is being considered by capitalists from Omaha, Neb.

Atlanta, Ga.—The cost of the Atlanta & Chattahoochee River Railway is estimated at $175,000. This electric road is to be completed by Feb. 15, and is to be 15 miles in length.

Fall River, Mass.—The Globe Street Railway lines have been purchased by a syndicate of Rochester, Syracuse, Boston and Providence capitalists for $600,000. Electricity will be used in the early spring.

The Pittsburgh and Birmingham Traction Company, of Pittsburgh, Pa., has ordered a 50-h. p. Ball engine from Dravo & Black, Pittsburgh representatives of the Ball Engine Company, Erie, Pa.

Cannot Use the Trolley.—The New Jersey Supreme Court has decided that the Trenton Horse Railroad Company and the Rapid Transit company, of Newark, do not have the right to operate an electric road by the trolley system.

Peterboro, Ont.—The charter for the new electric railway in this city, for which there are two companies applying, includes a stipulation that the company obtaining it shall provide and keep in repair 18 inches of roadbed on either side of the rails with stone pavement.

Middlesborough, Ky.—The Middlesborough Street Railway Company, the Middlesborough Water Company and the Middlesborough Electric Light, Heat and Power Company have completed a reorganization and have elected E. F. Powers president and E. M. Greenley secretary.

Savannah, Ga.—The City Suburban Railway officials at their recent annual meeting decided to equip the lines with electrity and appointed a committee to treat with the City Council in regard to

the matter. The following officers were elected: J. H. Johnston, president; E. J. Thomas, secretary; E. F. Schmidt, treasurer.

The Aurora and Chicago Interurban Railway, recently incorporated with a capital stock of $1,000,000, is an enterprise for the building of an electric road to operate between Aurora, Ill., and Chicago, with branches to Batavia, Naperville, and other suburban villages. It is expected to have the system in operation in time for the World's Fair.

To Use the Trolley.—The Board of Public Works has granted permission to the Jacksonville (Fla.) Street Railway Company to use electricity as a motive power. The board had previously restricted the company to use the storage battery, but decided at its last meeting to instruct the city attorney to insert the trolley system as an amendment to the ordinance.

The Metropolitan Electric Railway Company, of Springfield, Mo., which operates 19 miles of electric street railway, has increased its capital stock from $500,000 to $600,000, and its bonded indebtedness to $550,000, the increase to be used in extensions. Mr. B. F. Hobart is the president of the company. Among the new directors are Stephen B. Elkins, Richard C. Kerens, L. M. Rumsey, of St. Louis, and George W. Parker, of Springfield.

The Helena street railway systems, of Helena, Mont., have been consolidated under the name of the Helena Rapid Transit Company, with a capital stock of $500,000. The following are the officers of the new company: J. H. Lawrence, president; R. S. Vivian, vice-president; Geo. B. Child, treasurer; Geo. May, secretary. The consolidation represents 12 miles of street railway lines, which have been equipped to run by electricity, and it is expected will all be running by Feb. 1.

Brantford, Ont.—The Brantford Council has discussed the proposed electric steeet railway franchise. The promoters want a franchise for 30 years. This it was decided to reduce to 25 years. They also propose to put in the "T" track instead of the wide flange track. On this proposition a decision was rendered to enable a deputation to visit Buffalo and other cities to make the necessary inquiries. It is claimed that the substitution of electric service for the present horse car system will entail an outlay of $60,000.

LEGAL NOTES.

In the suit for infringement of patent instituted by Chas. A. Lieb against the Electric Merchandise Company, of Chicago, several months since, note of which was made in THE ELECTRICAL WORLD at the time, Judge Blodgett has recently rendered a decision strongly and emphatically in favor of the Electric Merchandise Company and against the claims of Lieb.

A suit has been filed in the Circuit Court of Valparaiso, Ind., that will decide the right of the City Council to extend the franchise of the Stratton Electric Light Company. The complaint states that the city has attempted to extend the contract for 10 years, and asks an injunction on the ground that the city had no right to enter upon such contract, and that the contract price is excessive.

Taxation of Electric Light Stock.—A company generating electricity and selling it to customers for power, illuminating, or heating purposes, is not a manufacturing company within the Pennsylvania statute, exempting the capital stock of manufacturing companies from taxation. This decision was given in the case of the Commonwealth vs. the Northern Electric Light and Power Company, in the Court of Pennsylvania.

Kaufman, Tex.—The Texas Court of Appeals has affirmed the decision of the lower court in the case of the Western Union Telegraph Company *versus* W. C. Green It is as follows: Appellee fully informed the operator of the importance of the message, and the necessity of its prompt delivery. Appellee offered to pay any amount for its prompt transmission and delivery. The acts of the operator induced Green to believe that the message would be repeated, whether it was or not.

A decision has been given in the case of the electric light plant sent from the Fort Wayne Company to the New Brunswick Electric Company and seized for undervaluation. The customs authorities, while finding there was an undervaluation, believe that it was not a fraudulent one. The undervaluation refers to the discount allowed, and amounts to about 7½ per cent. on parts of the material on which a discount of 60 per cent. was allowed. The company will pay the additional duty required, and the whole plant will be released.

Against an Edison Dividend.—Judge Andrews, of the Supreme Court, has issued an injunction restraining the Edison Electric Light Company and the Edison General Electric Company from declaring a dividend of 80 per cent. payable in collateral trust debentures of the Edison Electric Light Company, and from paying the same. The injunction was issued at the instance of Martin A. Frank, a stockholder of the Edison Electric Light Company. Mr. Frank some time since fought the proposed practical consolidation of the Edison Electric Light Company with the Edison General Company.

Telephone Companies are Common Carriers.—The same rules of law which apply to common carriers are applicable to telephone companies, and a telephone company operating under a public franchise, and offering the use of its system to the public at an established rate, is subject to the duty of serving all applicants alike, and it will not be permitted to refuse its facilities to any one complying with its general rules and regulations, or discriminate in favor of one or more subscribers as against others. This decision was rendered in the case of the Postal Telegraph Cable Company vs. the Delaware & Atlantic Telephone and Telegraph Company, in the United States Circuit Court.

Taxation of District Telegraph Stock.—The inventor and owners of certain appliances for the transmission of sounds (telephone), in consideration of certain shares of stock to be issued to them by defendant company, agreed that the latter should have the exclusive right to use such appliances in certain territory, the inventors and owners reserving the right to sell the privileges of using the same everywhere except in that territory, and also the ownership of the appliances actually used. The stock of defendant company issued to such inventors and owners was not an investment in "patent rights," within the laws of the United States exempting from taxation the capital stock of a company invested in patent rights. This decision was rendered in the case of the Common, wealth *vs.* Central District and Printing Telegraph Company, in the Supreme Court of Pennsylvania.

EDUCATIONAL NOTE.

The Electromathian Society, of Grand Rapids, Mich. recently gave an electrical exhibition under the auspices of the society, which it is stated was a pronounced success from a scientific educational standpoint. The success of the exhibition was due to the efforts of Mr. C. W. Carman, president of the society. Every department of electricity was represented by exhibits, the practical working and application of the various appliances being shown to good advantage by those in charge.

PERSONALS.

Lieut. F. B. Badt will pass the next few weeks in Washington in the interests of his company.

John Bragg, son of the late Governor Bragg, and well known in Virginia and North Carolina, died recently at his home in Wilmington, N. C., where he was Associated Press operator.

Mr. E. E. Winters, formerly with the power department of the Edison General Electric Company's Schenectady works, resigned his position Jan 1. His present address is 802 DeKalb avenue, Brooklyn, N. Y.

Mr. W. G. Meloon, formerly of Cincinnati, is the new superintendent of the Charlotte, N. C., electrical railway. Mr. Allen, the former superintendent, leaves for Pittsburgh, Pa., where he has accepted a position as an electrical expert.

Mr. H. G. Allis, president of the First National Bank of Little Rock, Ark., handed Chief Engineer Arnold, the Thomson-Houston expert who superintended the construction of the street railway lines, a $500 watch, with Jurgensen movement, as a Christmas present just as Mr. Arnold was returning north on the completion of the work.

MISCELLANEOUS NOTES.

Ishpeming, Mich.—The plant which was recently established at this place for the separation of iron ore by electricity is reported as being very successful. The works have so far turned out 30,000 pounds of Bessemer ore.

Electricity as a Motive Power.—A St. Paul inventor, it is stated, is to revolutionize the process of manufacturing flour. Within a short time a large flouring mill will be erected on the site of the St. Paul Roller Mill under the direction of Mr. Kingsland Smith, of St. Paul. It will be operated entirely by electricity. Mr. Smith some years ago invented the roller process, and now states that he has become thoroughly convinced of the cheapness and entire practicability of running even the heaviest flour mill machinery by electricity, that he thinks it will revolutionize the whole question of motive power and that within the coming two years all large manufacturing concerns will be run by electricity.

The American Association of Inventors and Manufacturers will hold its annual meeting in Washington on the 19th inst., probably at the Ebbitt House. Dr. R. I. Gatling, of Hartford, Conn., the inventor of the Gatling gun and an ardent supporter of the United States patent system, is president of the association, and Prof. J. Elfreth Watkins, of the Smithsonian Institution, Washington, secretary. The electrical industry is well represented in the association. Gardiner G. Hubbard, of Washington, whose name is so intimately associated with the telephone, and Prof. Wm. A. Anthony, of Manchester, Conn., are vice-presidents. Messrs. C. F. Brush, of Cleveland; David G. Weems and E. E. Reis, of Baltimore, are also among the officers. Such an association as this is very much needed, and it is important that it be kept alive and in vigorous working order. All interested in patents should unite their efforts to protect the patent system from the attacks of its enemies. They cannot do this in a more effective manner than by attending the forthcoming meeting and co-operating with the officers of the association in the good work they are doing.

The Pittsburgh Electrical Club's Reception.—The reception given by the Pittsburgh Electrical Club on Jan. 1 was attended by about 500 people at the club house, which is located at 8.2 Penn avenue. It is stated that the reception was the most elaborate which has been given in the city for some time, many attractive features being introduced, especially on the *menu*, among which was an "electric punch," which, it is stated, was very seductive. The Pittsburgh Electric Club has been in an embryotic state of existence for years, but recently its management has been changed, and with the infusion of new blood it is an organization of which the electric fraternity may be justly proud. At the first regular meeting of the club after it had been reorganized with 71 chartered members, officers were elected as follows: Morris W. Mead, chief of the Electrical Bureau of Pittsburgh, president; Eugene Ingold, of the Ft. Wayne Electric Company, vice president; James A. Rutherford, of the railway department of the Westinghouse Electric and Manufacturing Company, treasurer; J. E. Hall, of the Ft. Wayne Electric Company, secretary; H. McL. Harding and Ph. Lange, of the Westinghouse company; E. B. Gawthrop and D. W. Dunn, of the Thomson Houston company; Isaac A. Silverman and E. B. Kettle, of the Edison company, and W. N. Dillon, of the Brush company, board of directors. The club has obtained permanent quarters in the heart of the downtown portion of the city, which are complete in every detail for club purposes, with reception rooms, dining rooms, billiard and general reading rooms, all of which are elegantly fitted up. Electrically speaking, the year 1892 has opened up very auspiciously for the club.

Industrial and Trade Notes.

The Attica Electric Company, of Attica, N. Y., a company recently established at that place, has purchased one 80-h. p. and one 50-h. p. Ball engine, built by the Ball Engine Company, of Erie, Pa.

Ziegler Bros., electrical engineers, of 73 Federal street, Boston, contractors, manufacturers and dealers in electrical and mechanical instruments, have sent out a neat calendar, wishing a prosperous and a Happy New Year to all.

The Edison General Electric Company has opened a supply department in Pittsburgh in the Edison Building on Wood street, for lighting supplies and railway supplies, wires, etc. Shipments will be made promptly from that office.

The Morris European & American Express Company, Limited, of 18 Broadway, New York, is sending out circulars calling attention to the electrical exhibition to take place at Moscow, Russia, from April 14 to Nov. 14, 1892, under the management of the Imperial Technical Society.

James Schawel & Company, gold and silver refiners, assayers and smelters, and importers of platinum, at 29 John street, New York, report trade as first class. This firm makes a specialty of importing and refining platinum in all sizes, and of purchasing and exchanging platinum scrap.

Dynamo Oils.—George P. Jones & Co., 703 North Main street, St. Louis, Mo., have received the contract for supplying the dynamo and cylinder oils from one of the largest electric lighting stations in the country, their Peerless oils having been given the preference over all competing lubricants.

Lava Insulators seem to retain their popularity with electrical companies. The D. M. Steward Manufacturing Company, of Chattanooga, Tenn., which manufactures the insulators, says that the sales of lava insulators for 1891 were largely in excess of what they were during 1890 and that everything points to a still further increase during 1892.

One of the neatest catalogues which we have received in some time is that which is being distributed by the Electric Gas Lighting Company, of 195 Devonshire street, Boston. It is profusely illustrated and typographically perfect. It gives the latest price list of the electrical specialties manufactured and imported by the company, and consists of over 72 pages. It is a credit to the enterprise of the company.

Novel Incandescent Lamp.—A novel form of incandescent lamp has been introduced by the Electrical Supply Company, of Chicago, the western agent for the Sunbeam lamp. The new lamps are made in the shape of an acorn, and some of them have the cup at the base silvered, so that all of the upward rays are reflected by it. They are made in glass of all tints, and are largely used in decorative effects.

The Benedict & Burnham Manufacturing Company, of Waterbury, Conn., is just offering to the trade its new "Benedict" weatherproof wire, for which is claimed the highest insulation of any weatherproof wire made. The statement is the result of an number of tests made of this wire in competition with others, and wherever the wire has been introduced it has received nothing but favorable comment.

The Electric Appliance Company reports having closed arrangements for the general selling agency for the Standard lamp. The Standard lamp is a new competitor for favor among lamp users. The Electric Appliance Company has taken hold of this lamp only after a series of very severe tests, which have proven more than satisfactory. Very strong claims are made for long life, high efficiency and total absence of discoloration.

The Hart & Hegeman Manufacturing Company, of Hartford, Conn., manufacturers of electric light specialties, has recently been incorporated with a paid up capital of $20,000. The company will increase its facilities for the manufacture of the Hart switch, and will add several other specialties to its line. The officers of the new company are G. W. Hart, president; G. S. Hegeman, vice-president, and A. H. Pease, secretary and treasurer.

The Conover Manufacturing Company, 95 Liberty street, New York, consulting and mechanical engineers, have recently placed four of their new independent vertical steam pumps and condensers in the plant of the Newark (N. J.) Electric Light and Power Company, and six at the power house of the Buffalo (N. Y.) Street Railway Company. They report that these machines are meeting with great success, being particularly adapted for electric plants.

The Electric Merchandise Company, Chicago, reports unusual activity in the electric railway supply business. The company is kept busy filling orders received from all quarters. Its stock, heavy at all times, is being increased, and with enlarged quarters every provision is made for a lively spring trade. The present cold weather has brought inquiries and orders for Burton electric heaters, Brand's steel wire track brooms, and Wardwell's patent track broom holders.

Messrs. Gooding, Beinert & Co., of 80 John street, New York City, manufacturers of Leclanché and gravity batteries and electrical supplies, do electrical work of almost every description, as well as a large manufacturing business, particularly in the line of various porous cups. Since this concern started in business it has met with great success and is gaining a reputation for doing first class work with promptness and at reasonable prices. They endeavor to give the best satisfaction to everybody.

The Pond Engineering Company, through its Chicago office recently received an order for a 200-h. p. Armington-Sims engine for the Chicago Arc Light and Power Company's station, which was recently destroyed by fire. The engine was shipped complete from St. Louis within a day after the order was received and the railway company delivered it in Chicago six days afterward, and within three days from that time the engine was ready for operation in the plant of the company, and is now regularly running six 50-light arc dynamos.

The Eickemeyer-Field Apparatus, manufactured under the direction of Mr. Rudolf Eickemeyer at Yonkers, N. Y., is illustrated and described in a neat 30-page catalogue, which is being sent out for the purpose of calling attention more particularly to street car electric traction in connection with the Eickemeyer-Field apparatus. The illustrations are taken from photographs of work actually constructed and operated, and the descriptive part is from results of experience of years of actual operation. The advantages of the Eickemeyer-Field apparatus are very forcibly presented.

The Balance Valve and Steam Piston Packing Company, of 280 Broadway, New York, manufacturers of St. John steam piston packing, have recently issued a neat pamphlet of 35 pages containing testimonials of parties who have used the packing during the past few years, among which is noted the following from C. H. Mitchell, chief engineer, Thomson-Houston Electric Light Company, Detroit, Mich: "The St. John cylinder packing which you furnished for our Corliss engine has proven highly satisfactrsy, and fully justifies all you claim for it. Friction on the cylinder being reduced to a minimum, we find a marked economy both in steam consumption and cylinder lubrication. We would not be without it."

The Purity Oil Filter Manufacturing Company, of 107 First avenue, Pittsburgh, Pa., reports a splendid business, and among its recent sales to the trade are orders from Messrs. H. A. Rogers, Gilbert & Baker Manufacturing Company, W. R. Fleming & Co., Vacuum Oil Company, New York; Syracuse Supply Company, Syracuse, N. Y.; Monongahela Electric Light Company, Homestead, Pa.; Cincinnati Edison Electric Company; Melrose Milling Company, Evansville, Ind.; Central Traction Railway, Pittsburgh; Eagle Refining Company, Richmond, Va.; Macon Gas and Water Company, Macon, Ga.; Millvale Electric Light Company, Millvale, Pa.; Iron City Brewing Company, Pittsburgh; City Water-Works, East St. Louis, Ill.; American Encaustic Tiling Company, Zanesville, O.; Thomson-Houston International Electric Company, Boston, for export to Rio Janeiro, Brazil.

Thomson-Houston Railway Apparatus in St. Louis.—The Chicago office of the Thomson-Houston Electric Company has closed a contract with the Benton Bellefontaine Railway Company, St. Louis, for the equipment of 30 cars with two motors each of its latest improved type, known as the W. P. or "water proof." The contract includes the furnishing of three 333-h. p. compound wound generators of the Thomson-Houston manufacture, and it is understood that the railway company will do everything that is required to make this installation model, complete and perfect in every respect. The Thomson Houston company has its electric railway equipment in exclusive use in St. Louis on the following roads: St. Louis & Suburban, Union Depot, Mound City, Missouri Railroad, Suspension Bridge, and East St. Louis, and it is now generally conceded that St. Louis has more Thomson-Houston electric railway apparatus in use than any other city in the United States, with the single exception of Boston.

The Tropical American Telephone Company, Limited, has taken the agency of the Viaduct Manufacturing Company, of Baltimore, and will keep a line of goods of this company's manufacture in stock at No. 95 Broad street, New York, both for export and United States trade. This stock will consist of district telegraph boxes, under United States patents; magneto fire alarm system, under United States patents; fire alarm boxes and

tower strikers; magneto call bells, with patent telephone hooks; magneto power generators, under United States patents; extension bells and magneto bells; still burglar alarms under United States patents; dial telegraphs; electric push buttons; visual annunciators for call boxes; electric lamps and incandescent lamp trimming; electric thermostats; storage battery fixtures, dynamos and general brass and fine woodwork for electrical apparatus of all kinds. The Viaduct company owns and controls a number of important United States patents, covering many of the foregoing pieces of apparatus, and has a large well equipped factory run by water power at Relay House Station, of war time fame.

Business Notices.

Complete Equipment of electric light and power plants with the Mather system. Also agent for the Perkins incandescent lamp. E. T. Pardee, 14 Butler block, Syracuse, N. Y.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

The Brown & Sharpe Manufacturing Company, of Providence, R. I., announce that the prices of their swivel vises for use on milling and planing machines have been reduced. Price of No. 2 vise is $24; price of the No. 3 vise is $30. Former prices, $31 and $38.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED JAN. 5, 1892.

466,357. Electric Annunciator; Charles Molitor, of Chicago, Ill. Application filed Sept. 14, 1891. The combination, with a weighted arm of an annunciator indicating device, a vertically movable bar having a pin located in the path of said arm, an arm upon said bar, having adjacent concaved faces, and a pivoted lever, located to engage said concave faces.

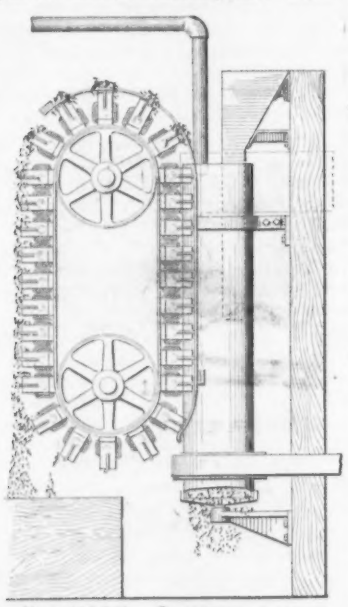
466,362. Electric Railway Crossing; William Osner, of Chicago, Ill. Application filed Oct. 16, 1890. In a crossing for electric railways, the combination, with conductor rails for each of the crossing tracks, said rails having breaks therein at the crossing and electrically connected by means of suitable connectors, of guide rails for the current transmitting device for the respective tracks, said guide rails being interrupted at the crossing and located in line with the conductor rails and insulated therefrom.

466,367. System of Electric Distribution for Railways; Nelson W. Perry, of Cincinnati, O. Application filed March 2, 1891. The combination, in a system of electric distribution for movable translating devices, of a sectional current conveyer, switches normally closing the gaps between the sections, two lines of sectional conductors, the corresponding sections of each line being connected with separate sections of the main current conveyor, supplemental conductors lapping one line of conductors and insulated therefrom, and electrical connections between the supplemental wires and the main current conveyer.

466,368. System of Electric Distribution for Moving Translating Devices; Nelson W. Perry, of Cincinnati, O. Application filed April 2, 1891. The combination, in a system of electric distribution for movable translating devices, of a sectional current conveyer, switches normally closing the gaps between the sections, and two lines of conductors arranged in pairs, the conductors in each line lapping but normally insulated from each other and the members of each pair being connected one with one section and the other with another section of the main conveyer.

466,391. Insulator; William S. Andrews, of New York, Assignor to the Edison General Electric Company, of same place. Application filed May 27, 1891. An insulator or similar device consisting of an insulating body provided with a groove or depression, a metal cap having means for connecting a wire to it, and having a corresponding groove or depression and a body of metal extending from the depression in the body into the depression in the cap.

466,400. Cut-Out for Incandescent Lamps; Thomas A. Edison, of Llewellyn Park and John F. Ott, of Newark, N. J., Assignors to the Edison Electric Light Company, of New York. Application filed Oct. 27, 1886. The combination in an incandescent electric lamp of a recessed insulating piece within its stem, the



No. 466,515.—Ore-Separator.

wires passing through the heads of the piece, staples in such recess through which said wires pass, a V-shaped spring having one end in contact with one of the staples, and a thread having electrical conductivity and secured to the staples and normally holding the other end of said spring out of contact with the other staple.

466,427. Extensible Electrical Conductor; Benton C. Rowell, of Boston, Mass., Assignor of one-half to D. Howard Vincent, of same place. Application filed April 13, 1891. The combination with the terminals of a discontinuous electrical contact-rod or trolley-wire, an extensible electrical conductor supported at one terminal, a projecting finger connected with said conductor and adapted to be operated by a passing car to extend the conductor across the space between the terminals, and a weight or spring to withdraw said conductor from that space when the car has passed.

466,447. Device for Electric Elevators; Rudolph C. Smith, of Yonkers, Assignor to Otis Brothers & Company, of New York. Application filed March 17, 1891. In an electric elevator, the combination, with an electric motor, a switch controlling the motor, and a hand-rope for controlling the switch, of a locking device for the switch and means connected to the hand rope for releasing the locking device.

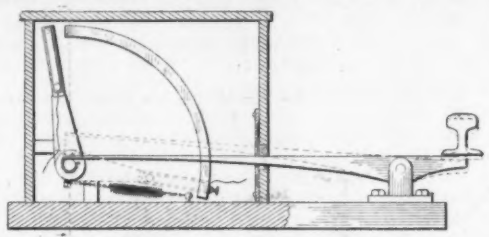
466,448. Commutator-Brush and Holder for Dynamo-Electric Machines and Motors; Frank J. Sprague, of New York, Assignor to the Edison General Electric Company, of New York. Application filed Dec. 10, 1886. The combination with a commutator cylinder, of an end-on commmutator brush having its end beveled in two directions and adapted to rock on either side of a centre.

466,450. Damper Controller; John V. Stout, of Easton, Pa. Application filed March 23, 1891. The combination of a valve or damper, a magnet for opening and a magnet for closing the valve, an armature or armatures for said magnets, a coupling between the valve or damper and the armature or armatures, said coupling being in positive engagement during the first part of a movement of the valve, but said positive engagement being broken during the following movement of the valve, said magnets being in circuits controlled by a thermostatic circuit controller, a circuit maker and breaker in the circuit of each magnet, in addition to the thermostatic circuit controller, and means moving with the valve to open the circuit through the magnet first energized, and to close the circuit at the circuit maker and breaker in the circuit of the other magnet.

466,471. Underground Conduit for Electric Railways; Charles P. Tatro, of Spokane, Wash. Application filed Nov. 14, 1891. The combination in conduits for electric railways of a series of pipe sections having an insulated wire in each, the wire having projecting branch ends, a branch coupling joining the adjacent ends of pipe sections, a branch pipe in the coupling covering the branch ends of wire, the said branches being secured together in a metallic contact, and a switch shield secured upon the said branch pipe over the end of the said wires.

466,492. Cable Telegraphy; Wilson E. Facer, of Cleveland, O., Assignor to George S. Iddings and M. M. Hobart, of same place, and George N. Morton and S. W. Wood, of New York. Application filed Dec. 22, 1890. In a system of telegraphing, an induction coil provided with a local circuit and opposed contact points in said circuit, a key extending between said contact points, and a line wire including a circuit closer controlled by the key.

466,505. Combined Electrical Protective and Time-Detecting Device; Jamin S. Morse, of New York. Application filed June 5, 1891. The combination, with a system of thermostat circuits centring at a given point, a time-recording mechanism, and independent recording-circuits corresponding to the thermostat circuits of a switch or bridge for simultaneously closing breaks in corresponding thermostat and recording circuits, an electromagnet included in the circuit of the bridge, and a circuit-controller in the recording circuits operated.



No. 466,519.—Circuit Controller.

466,508. Electric Switch; Gwynne E. Painter, of Baltimore, Md., Assignor of one-half to James F. Montrose, of same place. Application filed March 17, 1891. An automatic switching device for electric circuits, comprising a yoke-shaped supporting-base, electromagnets fixed thereon, a rocking lever pivotally supported at the apex of said base, armatures carried by the said lever and under the influence of the electromagnets, contact-plates upon the ends of the lever, contact-springs completing the main circuit through the said plates, and a circuit independent of the main circuit energizing the electromagnets. (See illustration.)

466,509. Electric Drop-Light; Gwynne E. Painter, of Baltimore, Md., Assignor of one-half to James F. Morrison, of same place. Application filed April 29, 1891. The combination, in an electric drop-light, of a shaft and a winding cylinder mounted thereon, a contact plate upon said cylinder, a circuit controller rotatably mounted upon said shaft, friction-fingers forming part of said controller, engaging the plate, and a segment of a wheel also forming part of the controller and made integral with said fingers, the said segment being adapted to complete the circuit of the drop-light through the fingers and contact plate.

466,510. Electric Lamp Socket Switch; Gwynne E. Painter, of Baltimore, Md., Assignor of one-half to James F. Morrison, of same place. Application filed March 17, 1891. A switch for electric lamps, comprising a stationary disc of insulating material fixed within the barrel of the lamp socket, an electromagnet or magnets fixed to said disc, an armature attracted by the magnet or magnets, means carried by the armature for actuating a rotatable conducting disc, and a contact completing the lamp circuit through the conducting disc.

466,511. Electric Lamp Socket Switch; Gwynne E. Painter, of Baltimore, Assignor of one-half to James F. Morrison, of same place. Application filed March 17, 1891. The combination, with an electric lamp socket, of two sets of electromagnets contained within said socket, a separate circuit independent of the lamp circuit for each set of magnets, a manual switch controlling the supply circuit and operated by either set of magnets, and spring detents connected in the lamp circuit and arranged to engage the lever, and thereby to control the lamp circuit in either of its operative positions.

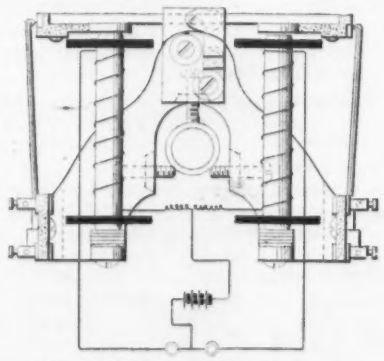
466,513. Ore-Separator; Charles John Reed, of Orange, N. J. Application filed Oct. 13, 1890. In an ore-separator, a hollow revolving drum through which the ore passes longitudinally, in combination with a fixed magnet outside of the drum.

466,514. Ore-Separating Machinery; Charles John Reed, of Orange, N. J. Application filed Dec. 1, 1890. In an ore-separator, a hollow drum having a roughened interior, in combination with magnets arranged exterior to the drum.

466,515. Ore-Separator; Charles John Reed, of Orange, N. J. Application filed April 6, 1891. An ore-separator having a hollow revolving drum, through which the ore passes longitudinally, in combination with one or more magnets carried in close proximity to the exterior surface of the drum, but detached therefrom and having a motion different from and independent of the motion of said drum. (See illustration.)

466,518. Apparatus for Synchronizing Clocks; Ludwig Von Orth, of Berlin, Germany. Application filed Jan. 23, 1891. In combination with a telephone system or other net work of wires, a master clock at the central station provided with a circuit closer, an auxiliary line, including the circuit closer and a battery, a resistance interpolated in the ground wire of the central station to divide the current, and a series of secondary clocks, all so arranged that on closing the circuit of the battery by the master-clock divided circuits pass over all the telephone subscribers' wires and to the secondary clocks of the clock subscribers.

466,519. Circuit Controller; Henry P. White, of Kalamazoo, Mich. Application filed April 29, 1891. The combination of a rail of a railway track, a fulcrumed lever having one end beneath and in contact with the under side of the rail, a swinging



No. 466,508.—Electric Switch.

lever constituting one of the terminals of the circuit, a chain attached to the axis of said swinging lever and to the free end of the fulcrumed lever which is acted upon by the rail, and the metal plate constituting the other terminal of the circuit in position for the swinging lever to come in contact therewith when the rail is borne down by the weight of the cars, whereby the circuit is closed. (See illustration.)

466,539. Car Truck for Electric Railway Cars; Peter M. Kling, of St. Louis, Mo., Assignor of one-half to Edward Verstraete, of same place. Application filed Dec. 26, 1890. This invention consists of a main frame composed of upper and lower side pieces to which is attached an inner frame consisting of side pieces and walls, one of which sides has suitable doors.

466,541. Electric Reciprocating Tool; Harry N. Marvin, of Syracuse, N. Y., Assignor to the Marvin Electric Drill Company, of same place. Application filed June 6, 1888. A generator for reciprocating tools provided with independent energizing circuits, consisting in the combination of a field magnet, a revolving armature, a complete or ring collector forming one terminal of the armature circuit, a partial ring collector forming the other terminal, a single brush bearing on the complete ring and two brushes in position to make contact with the collector alternately, and two working circuits, including, respectively, the coils of the brushes and leading from the two brushes of one collector to the single brush of the other.

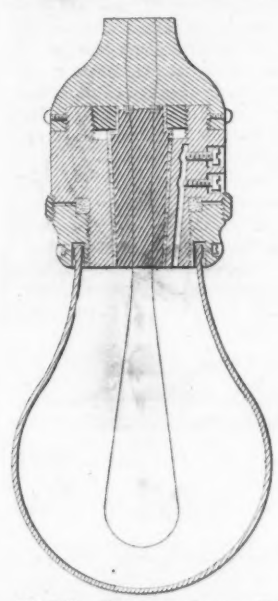
466,562. Incandescent Lamp; Perrin Grant, of Portsmouth, Va. Application filed July 7, 1891. In an incandescent lamp, the combination of a neck carrying the lamp globe and provided with a valved exhaust passage, with a removable cone-shaped plug carrying the leading-in wires, airtight packing between said neck and the plug, and a nut and cap. (See illustration.)

466,604. Electrical Signal Box; Thomas F. Gaynor, of Louisville, Ky., Assignor to the Gaynor Electric Company, of same place. Application filed Jan. 23, 1888. In combination with the circuit wheel train of an electric signal box, a winding shaft provided with a bevel gear and a winding stem having a bevel gear adapted to engage therewith and being provided at its outer end with a winding key. A stop wheel is secured upon the winding shaft adapted to engage with an index.

466,640. Multiple-Signal Transmitter; Charles E. Nash, of Newton, Mass. Application filed May 2, 1891. The combination, with a motor provided with a number of signaling-surfaces for transmitting distinct signals, a hand operative pull or starting device therefore and a hand operative signal selector by which the desired signaling surface is placed in control of the circuit, of a case inclosing said hand-operative devices and preventing access thereto when shut and a citizen's key or operating handle which may be introduced when the said case is shut, and projections operated by said key adapted to operate the hand pull and also to engage with the hand-operative pointer and move it to a definite position.

466,644. Electric Push; John F. Wollensa, of Chicago, Ill. Application filed Oct. 23, 1891. In electric pushes, the combination of a plate of insulating material, binding screws for holding both ends of the circuit wires arranged on the outside and both extending through into the interior to operate as contact points, a loose button to be pushed when it is desired to complete the circuit, and a rocking disc arranged intermediate to the button and to binding screws, which completes the circuit as it is pressed by the button through direct instrumentality of both binding screws.

466,664. Electric Battery; Patrick B. Delaney, of South Orange, N. J. Application filed Nov. 13, 1890. In a battery, the combination of the zinc and copper elements, a conductor leading from the copper element, and a jar within which the zinc and cop-



No. 466,562.—Incandescent Lamp.

per elements are contained and which is provided with an aperture near its edge, through which the conductor from the copper element passes.

466,686. Electric Meter; Charles K. Huguet, of New Orleans, La. Application filed Dec. 3, 1890. In an electric meter, the combination, with a closed receptacle, of an electrode projecting through the bottom of the latter and having an inwardly threaded eye, a cylindrical adjustable screw held and adapted to work in said eye within said receptacle, and an electrode provided with a head having an arm arranged opposite one end of said screw.

466,702. Multiple Switchboard Busy Test Circuit and Apparatus; Frank A. Pickernell, of Newark, N. J. Application filed Aug. 17, 1891. The invention consists in a busy test circuit and apparatus comprising a third wire for each metallic circuit through the switchboard uniting the several spring jack frames of each line, and a corresponding additional test wire leading to a battery and earth, provided in connection with each connecting plug and flexible conductor, combined with an operator's telephone whose electromagnetic helix has an earth wire branched from its centre.

466,726. Insulator; George B. Norgrave, of Philadelphia, Pa., Assignor to Richard I. Brewster, of New York. Application filed April 9, 1891. An insulating support for electric wires, consisting of a metal piece having integral jaws inclining outwardly and then inwardly, and two identical blocks of insulating material, having longitudinal grooves, having their sides inclined to correspond with the inclination of the jaws and tapering longitudinally.

466,760. Regulation of Dynamo Electric Machines; René Thury, of Geneva, Switzerland, Assignor to Cuénod, Sautter & Co., of same place. Application filed Aug. 4, 1891. In combination, a dynamo-electric machine, generator or motor provided with a rotatable arm or brush carrier, collecting brushes and auxiliary applied to said arm or brush carrier, an auxiliary electric motor, differential gearing between said auxiliary motor and arm or brush carrier, a relay for controlling said auxiliary motor, and circuit connections between said auxiliary or tell-tale brushes and relay.

466,761. Safety Fuse for Electric Conductors; James A. Wotton, of Atlanta, Ga., Assignor of one-half to John D. Easterlin, of same place. Application filed Oct. 12, 1891. In a safety fuse for electric conductors, a fragile high resistance element in circuit and an explosive substance associated therewith in such a manner as to be ignited upon the heating of said high resistance element.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.